ARMED FORCES CHEMICAL JOURNAL

September-October
1960

AMERICAN STRATEGIC POWER and the NEW HORIZONS for the CHEMICAL INDUSTRY

CBR Warfare	*Chemistry in the Air Force*
Strategic Air Command	*Strategic Army Corps*
Bio-Medical Aspects of Space Exploration	*Military Reactor Program*
Navy Missile Program	*Organization of the Military Space Effort*
Marine Corps Development Board	*Army Missile Program*
Protracted Conflict	*USAF Ballistic Missile Program*
R & D for the Army	*The ARPA Program*
The Coast Guards	*Air Materiel Procurement*
Requirements of Chemical Industry	

15th ANNUAL MEETING

ARMED FORCES CHEMICAL ASSOCIATION

National Headquarters

408-410 Park Lane Building—2025 Eye Street, N.W.

WASHINGTON 6, D.C.

(Federal 7-6823)

The members of this Association, mindful of the vital importance to national defense of chemistry, allied sciences, and the arts derived from them, have joined together as a patriotic obligation to preserve the knowledge of, and interest in, national defense problems derived from wartime experience; to extend the knowledge of, and interest in, these problems; and to promote cooperative endeavor among its members, the Armed Services, and civilian organizations in applying science to the problems confronting the military services and other defense agencies, particularly, but not exclusively in fields related to chemical warfare. (From Art. II, AFCA Constitution.)

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POLICY

The fact that an article appears in this magazine does not indicate approval of the views expressed in it by any one other than the author. It is our policy to print articles on subjects of interest in order to stimulate thought and promote discussion; this regardless of the fact that some or all of the opinions advanced may be at variance with those held by the Armed Forces Chemical Association, National Officers, and the Editors. It is the responsibility of contributors, including advertisers, to obtain security clearance, as appropriate, of matter submitted for publication. Such clearance does not necessarily indicate indorsement of the material for factual accuracy or opinion by the clearing agency.

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DALLAS C. HALVERSTADT

Defense Chemistry In The News
DR. WILLIAM T. READ, SR.

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USAR-(Ret.)

FRONT COVER

The 15th Annual Meeting which has just ended brought the subjects listed on the Front Cover into measurable quantities.

The artist, Mr. Charles Mendez, in drawing this cover has moved forward from last month's issue, when the cover portrayed chemical events of the future as seen in the early stages of development.

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ANNUAL MEETING HEARS DEFENSE CHEMISTRY NEEDS

PROGRAM

Roscoe C. Wilson
Lieutenant General
U.S. Air Force

"Welcome," by Dr. Jackson
ARMED FORCES CHEMICAL ASSOCIATION

UNITED STATES AIR FORCE
"Protracted Conflict"
DR. ROBERT STRAUSZ-HUPÉ
University of Pennsylvania

Break

"Strategic Air Command"
BRIG. GEN. PERRY M. HOISINGTON, USAF

"The Strategic Army Corps"
MAJ. GEN. DWIGHT E. BEACH, USA

"Organization of the Military Space Effort"
MR. ALVIN G. WAGGONER
Office of the Secretary of Defense

Lunch

Dr. Robert
Strausz-Hupé

"The U.S.A.F. Ballistic Missile Program"
COL. J. L. McCOY, USAF

W. R. Collins
Brigadier General
U.S. Marine Corps

"Atomic Energy Commission Military Reactor Program"
DR. FRANK K. PITTMAN
Atomic Energy Commission

Break

"Chemical Research in the Advanced Research Projects Agency"
DR. GENE V. MOCK
Department of Defense

"Chemical Biological Radiological Warfare"
MAJ. GEN. MARSHALL STUBBS, USA

T. J. H. Trapnell
Lieutenant General
U.S. Army

General Meeting, A.F.C.A. Membership

"The 1960 R & D Program for the Army"
DR. H. C. WEBER
Department of the Army

"Chemistry in the Air Force"
DR. AMOS G. HORNEY, USAF

"The Air Materiel Command (Procurement)"
COLONEL M. C. SMITH, USAF

Break

C. B. Martell
Rear Admiral
U.S. Navy

"Bio-Medical Aspects of Space Exploration"
BRIG. GEN. DON D. FLICKINGER, USAF

"The Navy Missile Program"
REAR ADM. C. B. MARTELL, USN

Lunch

"Concepts and Criteria of the Marine Corps Development System"
BRIG. GEN. WILLIAM R. COLLINS, USMC

T. J. Fabik
Captain
U.S. Coast Guard

"The Army Missile Program"
MAJ. GEN. AUGUST SCHOMBURG, USA

"The Coast Guard's New Requirements of the Chemical Industry"
CAPT. T. J. FABIK, USCG

"The Saline Water Conversion Program"
DR. ARTHUR L. MILLER
Department of the Interior

Banquet—The Cotillion Room

All Four Services Participate
AEC and Interior Send Speakers
Meeting Pronounced a Success

THE MEMBERS who came to the 15th Annual Meeting of the Armed Forces Chemical Association said it was one of the best they had ever attended.

During the two-day sessions, distinguished speakers presented 18 different subjects, all of them challenging. Topics ranged through the needs of military chemistry to atomic energy and reconversion of saline water.

The U. S. Air Force, host service for this 1960 meeting, presented its views of chemistry in space when Lt. General B. A. Schriever, Commander, Air Research and Development Command, spoke at the banquet which closed the meeting.

Chief of Naval Operations, Admiral Arleigh Burke, attended the banquet, as did Mr. A. Gilmore Flues, Assistant Secretary of the Treasury, Brig. General Bruno Hochmuth, Deputy Chief of Staff, U.S. Marine Corps, and Dr. Frank K. Pittman of the Atomic Energy Commission.

President Dwight D. Eisenhower sent his personal greetings to the Association members in a message to A.F.C.A. President Wendell F. Jackson, which said in part, "the knowledge and experience represented in your Association provides a splendid base for America's security and progress."

The ladies' program, which ran concurrently with the meeting schedule, included visits to points of interest around the nation's capital, and a luncheon which was given by Mrs. Bernard A. Schriever at Andrews Air Force Base.

Major General Marshall Stubbs, Honorary President of A.F.C.A., presented the Defense Department position in the need for defense against chemical weapons and pointed out that much of the information about these weapons which is needed by our civilian population must be distributed through civilian channels.

Major General August Schomburg, Commanding General, Army Ordnance Missile Command, invited the chemical industry—or, maybe challenged is a better word– to help solve the problems for new types of rocket fuels.

Chemistry in the Air Force, Dr. Amos G. Horney told the meeting, is the backbone of the Air Force technologies for today and tomorrow. Brig. General Don Flickinger, USAF, MC., described biomedical aspects of space travel, and said that the Air Force is seeking the chemical secret of life itself.

The Continental Room of the Sheraton-Park Hotel was filled and members were standing along the back wall when A.F.C.A. President Wendell Jackson made his talk of welcome and Colonel Donald W. Roberts, USAF, took the podium for the host service.

Capacity of the Continental Room is rated at 400 standees, but the majority of the crowd was seated and numbered at about 275 persons. It must be remembered, too, that the composition of the audience changed as various speakers arrived and departed with their own

personnel and equipment. Many of the speakers used visual aids in the form of charts and graphs, or motion pictures, while others used actual equipment for their demonstrations.

The meetings were closed to all except properly registered persons.

The first speaker, with his subject *"Protracted Conflict,"* set the whole crowd buzzing. He was Dr. Strausz-Hupé, University of Pennsylvania, who described the weapons of communism in 1917 as a leaky fountain pen, a coffee cup and a glass of water; at the table sat Lenin. What then, he asks, is the reason for our present dilemma? His entire speech is re-printed in this issue of THE JOURNAL.

Coffee was served, on the mid-morning and mid-afternoon breaks, next to the Continental Room. A press room had been set up in the hotel.

The registration desk was in the hotel lobby just ahead of persons entering the hotel. It was kept in operation during the whole sessions and served as a central information point for those in attendance.

Both entrances to the Continental Room were on either side of the registration desk. A bulletin board was put into use for members who wished to receive messages, and it worked very well in most cases.

There was a shortage of copies of speeches, for one reason or another, but whenever this happened it was beyond control of the Meeting Committe. For example,

(Continued on page 4)

Left to Right: Brig. Gen. C. B. Shadle, USA (Ret), Brig. Gen. G. C. Essman, Col. Sam Efnor, Jr.

Left to Right: Lt. Col. D. A. McWhirter, USAF, Col. Don Roberts, Miss Clare Murrell, Office of the Secretary of the Air Force.

AFCA's ANNUAL SAFETY AWARD, presented to Colonel Carl S. Casto (center), Commanding Officer U.S. Army Biological Laboratories, Fort Detrick, Maryland, by Dr. Wendell F. Jackson, President, Armed Forces Chemical Association, at the annual association meeting in Washington, is passed on to Mr. Everett Hanel, Jr. (right), Agents Branch, Office of the Fort Detrick Safety Director, at ceremonies held at Detrick. Attending the presentation were Dr. Harold N. Glassman, Asst. Deputy Commander for Scientific Activities.

SINGING SERGEANTS: USAF men in a medley of Irish songs for the dinner guests.

Left to Right: Mr. Donald MacArthur, Mrs. Wendell Jackson, Col. John F. Daniels, Mrs. Bruno Hochmuth, Mrs. Marshall Stubbs, Rear Admiral Thomas A. Robbins, Jr., Mrs. Bernard A. Schriever, The Honorable A. Gilmore Flues.

Left to Right: Dr. Wendell Jackson, Mrs. A. Gilmore Flues, Admiral Arleigh Burke, Mrs. Thomas Robbins, Jr., Major General Marshall Stubbs, Mrs. Floyd Hansen, Brig. General Bruno Hochmuth.

LIEUT. GEN. BERNARD A. SCHRIEVER, USAF
Banquet Speaker

LADIES' PROGRAM

MRS. BERNARD A. SCHRIEVER
Honorary Chairman

September 15, 1960

Coffee in the Adams Room.
Depart for Andrews Air Force Base.
ARDC briefing.
Luncheon at the home of Mrs. Schriever.
Afternoon free for sightseeing, shopping or other activity.
Reception for all meeting attendees.

September 16, 1960

Coffee in the Adams Room.
Depart for Pentagon tour and briefing, visit Lee House, Tomb of the Unknowns and Iwo Jima Memorial.
Luncheon at Little Tea House.
Bus returns to Smithsonian Institution for visit to gallery of Inaugural Gowns of the First Ladies, jewel collection including the Hope diamond, et cetera.
Fifteenth Annual Banquet—Cotillion Room

ANNUAL MEETING

(Continued from page 3)

Admiral Martell, who spoke on the "Navy Missile Program," did so without prepared text.

The Sheraton-Park, which is located west of the downtown section of Washington, is on Connecticut Avenue about 10 or 15 minutes by bus or taxi from the White House. It is one of the Washington hotels that can accommodate a meeting or convention in self-contained style on its premises.

The banquet on the final evening of the meeting was held in the Cotillion Room, and was attended by some 400 ladies and gentlemen.

Guests at the banquet heard the Air Force Singing Sergeants, who ended a 15-minute program with a medley of songs of all four armed services.

General Schriever speaking at the banquet stated that "the two most far-reaching breakthroughs in modern times are chemical processes . . . one is the release of energy through the study and application of the processes of physical chemistry, . . . the other is practical development of space flight by rocket propulsion."

The meeting, keyed as it was to the theme "American Strategic Power and the New Horizons for the Chemical Industry," brought the challenge for chemistry clearly into focus for all those in attendance. Although the scope of many of the subjects covered a wide range of problems, the fact always remained that work, inventiveness, and materials of chemistry will play a big part in the solutions for our future existence.

Short excerpts from various speeches, talks and presentations at the two-day meeting follow:

Organization of the Military Space Effort, by Alvin G. Waggoner: "The proposal to have all guided missiles developed by one agency received serious consideration in each of the guided missile reviews. In each case, however, it was found that no one Service, nor one single command had a more dominant interest in all potential uses of guided missiles."

The USAF Ballistic Missile Program, by Colonel John L. McCoy: "I hope to provoke thoughtful interest on your part and to enlist your support in defining and prosecuting technological and chemical advances to further the 'invasion' of the space frontier."

Chemical Research in ARPA, by Dr. Gene V. Mock, speaking on research: for ". . . chemical release in the upper atmosphere . . . advanced energy conversion . . . materials research . . . solid propellant chemistry. . . ."

CBR Warfare, by Major General Marshall Stubbs: ". . . comments now being received about CBR show a reasoned and objective consideration, and are quite different from those of a few years ago which were largely emotional and factually incorrect."

Chemistry in the Air Force, by Dr. Amos G. Horney: ". . . the Air Force has even more important interest in the science of chemistry *tomorrow*."

Air Material Command Procurement, by Colonel M. C. Smith: "Our objective today is to examine Air Force relations with industry and to develop specific

(Continued on page 5)

August Schomburg
Major General
U.S. Army

Dr. Arthur L. Miller

Dr. Gene V. Mock

Dr. H. C. Weber

Don D. Flickinger
Brigadier General
U.S. Air Force

Dr. Amos G. Horney

Mr. Alvin G. Waggoner

ANNUAL MEETING

(Continued from page 4)

programs for the improvement of the quality of negotiation both by industry and the Air Force."

Biochemical Aspects of Space Exploration, by Brig. General Don D. Flickinger: "How can we provide for the safety and functional effectiveness of our first space pilot?"

Coast Guard's New Requirements of the Chemical Industry, by T. J. Fabik: "Since World War II there has been remarkable progress in painting systems. . . ."

Saline Water Conversion, by Dr. A. L. Miller: "We will open bids for a second one million gallons per day plant to be located at San Diego, California. This plant is also expected to produce fresh water from the sea for about $1 per thousand gallons. As exciting as this product may be, we stand on the threshold of fresh from the sea at a price considerably below that figure. Our studies indicate that when (saving) processes are incorporated into plants of 25 million to 50 million gallons per day we can expect fresh water for less than 50 cents per thousand gallons."

General Schomburg in speaking of **Rocket Fuels** said that the Army was searching for satisfactory liquid propellants because these fluids can be controlled by valves. He invited the membership to probe into this subject.

General Schomburg provided one of the lighter moments in serious presentation when he demonstrated the directional use of two ferrite coils picking up low frequency transmission from a transmitter. Mr. C. W. Hayes, Celanese Corporation, Chairman of the Arrange-

(Continued on page 6)

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Lt. Col. D. A. McWhirter, Technical Executive Officer, Directorate of Research and Technology, Deputy Chief of Staff for Development, USAF. Colonel McWhirter acted as liaison officer in charge of the meeting.

Coffee Break, Left to Right: Lt. Col. John Moran, Capt. Rebecca Bennett, Maj. Donald G. Frier.

Dr. Frank K. Pittman

Marshall Stubbs Major General U.S. Army

Meeting Members, Left to Right: Col. Harry A. Kuhn, Maj. General Wm. M. Creasy, USA (Ret), Maj. General Marshall Stubbs, Chief Chemical Officer, Brig. General Clifford A. Sayre, USAR (Ret).

ANNUAL MEETING

(Continued from page 5)

ments Committee, was given the coil and blindfolded and asked to find the transmitter. This transmitter was located where the tail is pinned on the donkey— or, in this case, eledonk, an animal with the head of an elephant and the body of a donkey, to keep the meeting non-political in an election year. If Mr. Hayes moved out of the line of signal, he got a bell ring on one side and a buzz on the other. When there was silence he was on the "beam."

He pinned the tail of the ele-donk with little trouble, and with smiles and laughs from the crowd.

Other speeches besides the one printed in this issue may be reprinted in full in future issues of THE JOURNAL. Space limits the publication of all of them at one time.

Already AFCA members are asking what about plans for the next meeting.

15th ANNUAL MEETING COMMITTEE

General Chairman

REAR ADMIRAL MARTIN P. HOTTEL, USN (Ret.)

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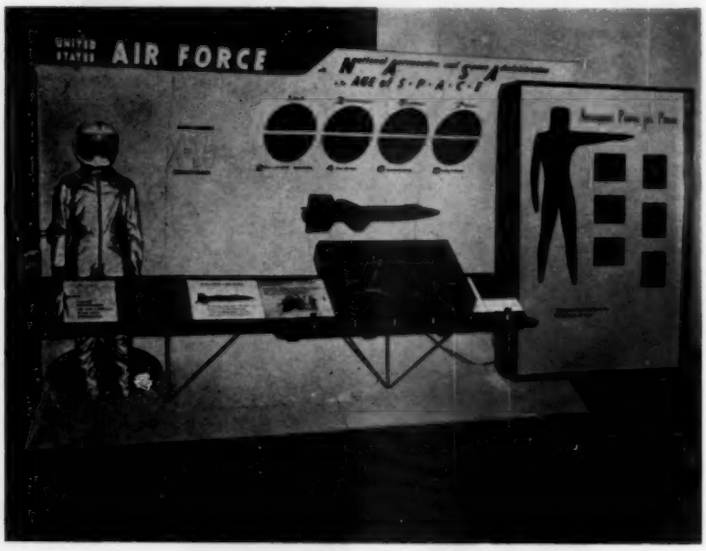

U.S. Air Force

U.S. Army Chemical Corps

WESTERN UNION TELEGRAM
GOVT PD WUX THE WHITE HOUSE
WASHINGTON DC 13
WENDELL F JACKSON PRESIDENT
ARMED FORCES CHEMICAL ASSOCIATION
IT IS A PLEASURE TO SEND GREETINGS TO
THE MEMBERS OF THE ARMED FORCES
CHEMICAL ASSOCIATION ASSEMBLED IN
WASHINGTON FOR THEIR FIFTEENTH
ANNUAL MEETING.
THE CHEMICAL INDUSTRY CONTRIBUTES
MUCH TO THE STRENGTH OF OUR NATION.
THE KNOWLEDGE AND EXPERIENCE
REPRESENTED IN YOUR ASSOCIATION
PROVIDE A SPLENDID BASE FOR AMERICA'S
SECURITY AND PROGRESS.
I AM DELIGHTED TO ADD BEST WISHES
FOR A FINE MEETING.

DWIGHT D. EISENHOWER

DEPARTMENT OF THE AIR FORCE
Washington

OFFICE OF THE SECRETARY

Dear Mr. Jackson:

On behalf of the Department of the Air Force, I send greetings to the Armed Forces Chemical Association on the occasion of its fifteenth annual meeting. We in the Air Force recognize the important contributions to national defense being made by the Association and its members, and we are honored this year to be your host Service.

Please express my sincere regret that I am unable to be present on this significant occasion and my best wishes for another fruitful year.

Sincerely
S/ DUDLEY C. SHARP

Mr. Wendell F. Jackson
President
Armed Forces Chemical Association
Washington 5, D.C.

SECRETARY OF THE ARMY
Washington

August 24, 1960

Dear Dr. Jackson:

I should like to extend congratulations and best wishes on behalf of the United States Army to all members of the Armed Forces Chemical Association on the occasion of your 15th Annual Convenvention.

The Army must visualize today the weapons and equipment it will need in the future. This requires efficient utilization of all our resources and the application of our combined scientific and technological knowledge to military problems in order that our Nation shall remain strong.

In this effort the Armed Forces Chemical Association sets a remarkable example of teamwork among Science, Industry and our Armed Forces.

We in the Army are grateful for your loyal cooperation.

Sincerely
S/ WILBER M. BRUCKER
Secretary of the Army

Dr. Wendell F. Jackson
President
Armed Forces Chemical Association
408-410 Park Lane Building
2025 Eye Street, N.W.
Washington 6, D.C.

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DIEPOXIDES

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For copies of two research reports, "Resin Forming Reactions of Epoxide 201" and "High Temperature Epoxy Resins," and a complete package of technical information, write Dept. H, Union Carbide Chemicals Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.

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PROTRACTED CONFLICT

By

DR. ROBERT STRAUSZ-HUPÉ

Foreign Policy Research Institute
University of Pennsylvania

Robert Strausz-Hupé: Appointed Special Lecturer, University of Pennsylvania, 1940; Associate Professor of Political Science, 1946-52; Professor of Political Science, 1952; Chairman, International Relations Group Committee, 1952-59; Director, Foreign Policy Research Institute, 1955-; Lecturer, Air War College, Army War College, National War College, Armed Forces Staff College, National Defense College; Director, National Strategy Seminar, National War College, Summer 1959; Consultant, the President's Committee to Study the U.S. Military Assistance Program (Draper Committee) 1959; Consultant, U.S. Senate Foreign Relations Committee, 1959; Consultant, Rockefeller Brothers Fund, 1959; Lt. Col., USAR, (Ret.).

Text of the talk made by Dr. Robert Strausz-Hupé at the 15th Annual Meeting of the Armed Forces Chemical Association, September 15, 1960, at Washington, D.C.

MY FELLOW authors and I—we who have written the book *Protracted Conflict*—wish to express our thanks to Mr. Khrushchev who thus far has never failed to supply additional illustrations in point for our book.

Only a few months ago I would have opened this address by an appeal to your sense of urgency. I would have insisted that it is later than we think.

That part of my lecture I scratched. There is no necessity for talking to you about the urgency of our foreign policy and security problems. The moment of decision or, as our Spanish friends say, "la hora de verdad"—the hour of truth—is upon us.

We must now ask ourselves the question: what is the reason of our present dilemma? Why, for the last 15 years, have we been forced to retreat step by step from one position of strength to the other until our own homeland is exposed now to enemy action, and until the enemy has been able to establish forward positions of his own within the close vicinity of our home base?

Melancholy Course

Now, I believe that the chief reason for this melancholy course of events which leads from the height of our power in 1945 to our present embarassment, is an intellectual failure which, in turn, has resulted in a moral failure.

We are being told, *ad nauseum,* that we are living in a revolutionary age. This term is now a cozy cliché. Virtually every advertisement now speaks about the revolutionary age within which we live. Yet, exactly what kind of revolution are we living in? On this point ideas diverge, and we are apt not to see what is the most obvious. We are apt to see all the local and short-lived revolutions around us but we are unaware of the great, the epochal revolution of our times.

In our book, *Protracted Conflict,* we have tried to analyze this revolution, and we came up with a new term: "systemic revolution."

What do we mean by "systemic"? We mean a revolution that alters the entire state system under which mankind lives.

Recorded history tells us about only a few of these systemic revolutions. The first of which we know is the one that gripped the ancient world. It lasted roughly 400 years. It started with the Peloponnesian wars which engulfed the Greek city-states, and it ended with the wars of the heirs of Caesar and the establishment of the universal Roman empire.

Rome Vs Greece

That universal Roman empire was a state system wholly at variance with the system of the Greek city-states. There were no longer these numerous, independent centers of power based upon a few square miles of territory. There was now the vast, uniform, universal, centrally-administered empire of Caesar Octavian Augustus and his successors.

This particular systemic revolution affected not only the political system of Greece and Rome but of the entire ancient world. It gave rise to profound changes in the mores and way-of-life of the peoples of the ancient world, Roman and not Roman.

The Roman empire was replaced by another systemic revolution out of which emerged a system wholly at variance with the centrally-administered, secular empire of Rome, to wit, the feudal order of the Middle Ages, a quasi-religious order, loosely composed of innumerable feudal fiefs.

And again a systemic revolution overthrew the feudal order. It started at the end of the 14th century, and it brought forth a new system of international order, namely, the nation-state system, within which we still live.

Systemic Revolution

The new age opened the emergence of the first great "nations," Spain, France and England. In the 19th century Italy and Germany joined the ranks of nation states. Lesser nations were born in World War I. The system still proliferates in Asia and Africa, although it too now is being engulfed by a new systemic revolution.

This is the fundamental fact of our age: We again live in a systemic revolution, the outcome of which we cannot foresee. We only know that a nation-state system is on its way out and that a new order is in the making.

Up until the end of the 19th century, the nation state was a viable unit of international relationships. It was just large enough for purposes of administration. It was able to defend the security of its citizens and to insure their prosperity.

We know today that not even the largest nation state can defend its security by its own means and insure the prosperity of its people by its own means. Not even the United States and the Soviet Union are self-contained and self-sufficient, although they deviate significantly from the traditional nation-state and represent an intermediate stage in the process of transition towards a new world system.

Forces in Play

What were the forces that have triggered the contemporary systemic revolution?

(Continued on page 10)

DOW

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Agricultural Chemicals
Plastics
Magnesium

DOW

THE DOW CHEMICAL COMPANY
Midland, Michigan

PROTRACTED CONTRACT

(Continued from page 8)

The industrial revolution enormously increased the interdependence of mankind. The industrial revolution sparked, in turn, the scientific-technological revolution which now accelerates the development toward a greater unity of mankind, a development that no one has planned and which the nation state seeks to resist but which the pressing interdependence of all peoples now makes mandatory.

We know from trends that already are perceptible now that this revolution is speeding up at a fantastic rate. We know that we stand on the eve of the wide diffusion of weapons of mass destruction that are powerful enough to annihilate not only this or that peoples but entire civilization. Even now there are several states who could fashion these weapons within the near future were they determined to devote their technological and economic resources to this purpose.

We also know that we stand on the eve of population explosion the like of which mankind has never seen. We know that within another 30 or 40 years the population of this globe will have nearly doubled, that the two and a half billion which now inhabit this earth will have increased to five billion.

Political Order Strained

We know—and if we do not know it by scientific deduction, then we know it by intuition—that problems like these—the predictable increase of states armed with atomic weapons and other weapons of mass destruction and the tremendous pressure of population—must strain to the breaking point a political order that was not designed to meet such a universal challenge and was obsolescent even before the coming of the atomic bomb and intercontinental artillery. The old order is falling and, in its fall, it is being pushed by social, economic, psychological and moral forces that the scientific-technological breakthroughs have set free.

This is the real revolution of our times. The one and only secret weapon that the communists have wielded successfully and have wielded virtually unopposed—the weapon that we have not been able to fashion and still do not possess now—is their understanding of these revolutionary forces and their techniques for exploiting them.

The communists are armed with a theory, the Marxist-Leninist theory of revolution. This theory is in many ways obsolete. Many of its conclusions are wrong. Yet it is a coherent theory of historical process—and it does give insight, limited and dogmatic though it may be—into the nature of the world struggle and the problem before mankind.

Doctrine of Conflict

It is a doctrine of conflict. This, incidentally, is one of the reasons why we, the free, democratic peoples, have had such great difficulty in measuring up to the strategies and tactics of the communists. Our political theory and practice are based upon the ideal of peaceful cooperation. Theirs are based upon a revolutionary concept of strife.

Now, it is a theory, and the insight it affords in historic process and conflict techniques designed to exploit that historic process, which is at the root of the communist success. While they were unable to grasp all of the meaning of the systemic revolution, they were able to understand enough of its true causes and hence to harness enough of its forces to their quest for power to wrest the initiative from the great democracies who, although they were more powerful and richer than the countries under communism, did not understand the real nature of world conflict and hence could not employ effectively their power and wealth for the purpose of fighting it.

You might think that this is an overstatement and that I am giving here more credit to the efficacy of communist theory and practice than is their due. But let us look at the story of communist power. If it was not ideas and skill in applying these ideas, how did it come to pass that the communist empire has grown within less than 50 years from an area two feet in diameter to the better part of Europe and Asia to which have been added several communist dependencies and client states all throughout the globe?

Communist Power Base

In 1917, the power base of communism was a marble-top coffeehouse table in Zurich. What was the weapons system of communism at that time? It was a leaky fountain pen, a coffee cup and a glass of water. At the table sat Lenin. From there he edited the clandestine newspaper of the communist movement, *Izkra*, with a total circulation of about 3,000. Out of Lenin's head came the ideas and directives which guided the communist movement in its fabulous advance to power. Indeed, a doctrine and Lenin's conceptual power, a method and a handful of professional revolutionaries working that doctrine and that method under Lenin's guidance, constituted the weapons system of communism. This was the sum total of communist power.

Against it were arrayed all the forces of the *status quo*, the enormous resources of the capitalist democracies who were just about to win the first world war. Yet the communist movement advanced, within less than 50 years, from a power position approximating zero to the rule of nearly half of mankind. Up until a few years ago, the physical strength of communism was far inferior to the combined power of the free peoples. Yet the free peoples did not combine their power and make a stand against their implacable enemies.

K Looks Forward

The communists now occupy a position where they need no longer speak of the capitalist encirclement, but where they can look forward, according to Mr. Khrushchev, to the socialist encirclement of the so-called capitalist-imperialist states. Of the states thus marked we happen to be the leading one.

This success either is due to a miracle or was achieved by means that can be analyzed rationally. I prefer the latter explanation. Communist success was gained by intellectual prowess and by that sense of purpose that is nourished by insight. It follows that as long as we cannot match that intellectual prowess, do not gain insight into the nature of the forces of change around us, and do not develop revolutionary techniques of conflict of our own—and I use here the word "revolution" in its classic connotation, that is, fundamental change that begets the new—then our day is done. Then, too, we will not be able to execute our own historic mission.

Let me hasten to say that I do not believe that the Soviets are geniuses and that we are oafs. Man for man we are at least as intelligent as they are and, in all likelihood, more intelligent. As a people, we are more versatile and resourceful. We still are vastly superior to them in all the physical and intellectual resources upon which real power is based—except for the power of political abstraction. We lack nothing but the ability to organize our political thinking in accordance with the felt necessities of the times and to apply the right political action.

Society Failed

It is in this realm alone that we have failed. It is not

(Continued on page 22)

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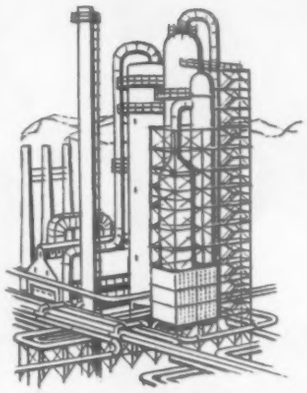
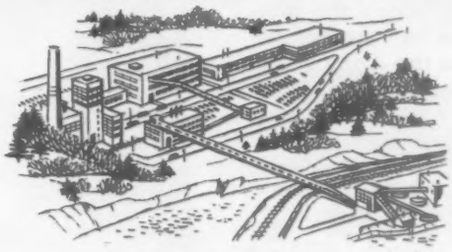
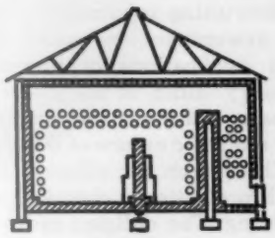


Petroleum Refineries

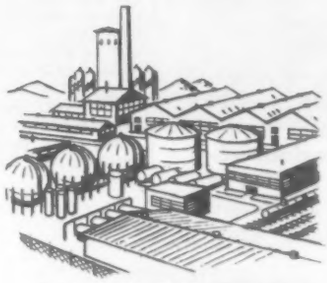


Pulp and Paper Mills

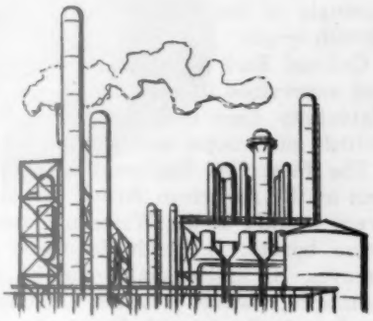


Oil Heaters
(Oil Heater Division)

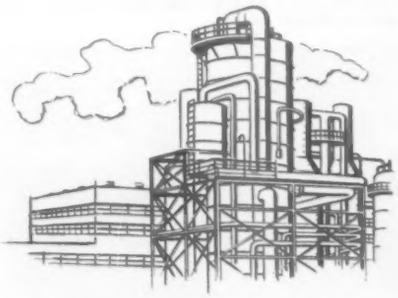
Economic Study and Consulting Services



Agricultural Chemical Plants

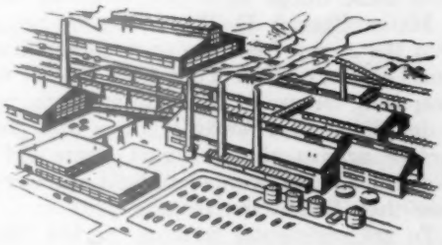


Petrochemical Plants



Chemical Plants

Pilot Plant Work
(Engineering Development Center)



Metallurgical Plants

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CHEMICAL CORPS HONORS BIRTHPLACE

Adjutant of 1st Gas Regiment Places Plaque at American U.

1ST GAS REGIMENT TRAINS AT AMERICAN UNIVERSITY

U. S. Army prepares for chemical defense

A group of red-blooded Americans, most of them youths, are daily training in gas and flame fighting, which is a new wrinkle in the American Army.

The organization is made up of volunteers, and it offers more possibilities of adventure and action than almost any other branch of the service, were the reports the Washington *Evening Star* brought to its readers in November 1917, about the early beginnings of the First Gas Regiment in training on the campus at American University.

Recruiting information for the Regiment was carried in newspapers, technical journals and the magazines and publications of professional societies across the country. Much of the credit went to the editors of these papers and journals for finding men who understood the scientific nature of this new warfare.

The search for officers was pursued among the men with professional chemical, engineering and mechanical training. The enlisted cadre came from the Army engineers, and what became the First Gas Regiment was originally known as the 30th Engineers.

Our Army was without a single gas mask. Livens projectors, Stokes mortars, and other chemical equipment was to be found for the most part in the training manuals of the day. Many of these manuals were of British origin.

Colonel Earl J. Atkisson commanded the Regiment and supervised its training on the campus at American University, then took the troops through training with British gas troops, and led the unit into combat.

The First Gas Regiment was the only offensive gas unit in the American Army. It was in action on nearly every section of the Western Front from Ypres to the Swiss border. It fought in three great American offensives. Its first casualty was Lt. Joseph T. Hanlon of Baltimore, whose father managed the Baltimore Orioles. A German shell struck the Lieutenant while he was near Villers-sur-Fere.

Colonel Amos A. Fries, who was in charge of the gas troops in Europe, credited Colonel Atkisson's desire for combat for the First Gas Regiment as the main reason why these troops were able to prove themselves.

Major Charles P. Wood, regimental adjutant, came into the Army from the engineering firm of Lockwood and Greene, of New York City. One of the problems in preparing for use of chemical weapons, he believed, was a doubt by some Army regulars that gas would be effective against the Germans. Some old timers, Major Wood once said, wanted to fight the Germans the same way they fought the Indians.

To get regimental training started, Major Wood was issued $250 to devise a home-made mortar to fire simulated gas filled shells.

"I bought a piece of eight-inch pipe and a bucket, just the size to fit inside the pipe. Then with blasting powder we retired to a ravine on the campus to fire the thing.

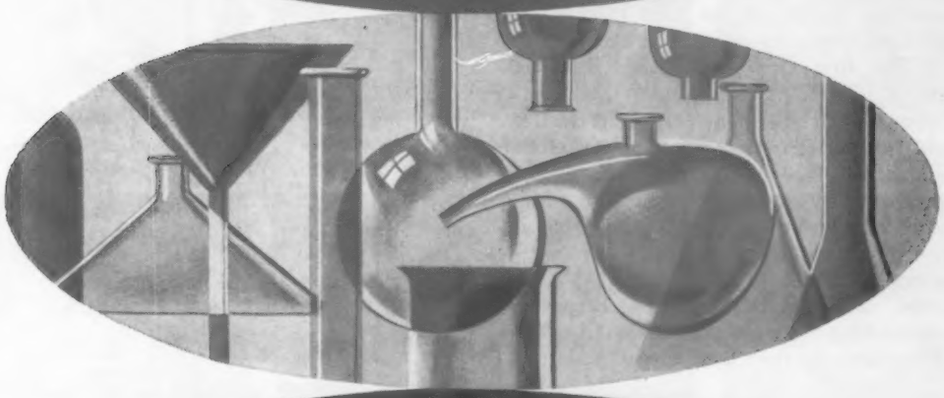
"The bucket was filled with water to simulate a chemical-filled shell. We tried several times, using more powder each time to get an increased range.

(Continued on page 14)

The American University, Washington, D.C., was honored as the "Birthplace of the Army Chemical Corps." A plaque was unveiled on McKinley Hall on the campus at the morning ceremony by Colonel C. P. Wood, former Adjutant of the First Gas Regiment and now President of the Regimental Association. Acceptance was made by American University President Hurst R. Anderson and U.S. Army Chief Chemical Officer, Major General Marshall Stubbs, spoke. A tour man color team paraded and the 12-piece U.S. Army Band presented a concert. Left to Right: Colonel Wood; Major General Amos Fries, retired, Chief of the Gas Service under General John J. Pershing and First Chief Chemical Officer from 1921-1924; and Major General Stubbs.

The Experiment Station for chemical weapons on American U. campus in World War I.

CSC



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CHEMICAL CORPS HONORS BIRTHPLACE

(Continued from page 12)

"Finally, I decided to see what it would really do, and we dumped a big batch of powder in the muzzle and fired away. The last time I saw the thing it was disappearing over the trees into one of the nicest residential sections of Washington," Major Wood said.

Soon another 150 acres was added to the campus and all soldiers of the regiment were given basic training and also fired Stokes mortars and Livens projectors on a newly constructed range.

The trustees of American University had offered the use of their campus and buildings for war work. Tents and barracks went up to house the first regiment of foresters, and the first company of camouflagers in the American Army. The first Gas and Flame Regiment was another first.

The campus served as a chemical center as well as a training ground, and defensive as well as offensive measures in chemical warfare were studied there. The Chemical Warfare Service, by the time the war ended, had a technical staff of approximately 1,000 persons and another 600 non-technical workers housed in some 70 buildings at American University.

Colonel Atkisson, who commanded the Regiment, later was the commanding officer of the Army Chemical Center. Colonel Fries became the Chief Chemical Officer of the Army.

HEADQUARTERS FIRST ARMY,
AMERICAN E. F.
OFFICE OF CHIEF GAS OFFICER

November 8, 1918

From: Chief Gas Officer.
To: Commanding Officer, 1st Gas Regiment.
Subject: Operations beginning November 1st.

1. In transmitting herewith advance copies of General Orders 31 and 32, Headquarters First Army, concerning the victory won by the First American Army since November 1st, I take great pleasure in adding that reports received from various sources in the Army testify to the assistance given by the 1st Gas Regiment in bringing about this happy result. The knowledge of the excellent work done by the Regiment in this and past operations will be a source of gratification not only to its personnel, but to all officers and men belonging to the Chemical Warfare Service.

JOHN W. N. SCHULZ
Colonel, C.W.S.

GENERAL OF THE ARMIES
JOHN J. PERSHING

Whether or not gas will be employed in future wars is a matter of conjecture, but the effect is so deadly to the unprepared that we can never afford to neglect the question.—Final Report of General John J. Pershing.

Employees of the chemical shell loading plant.

Pit for testing gas shells. Campus buildings in the background.

Capt. Hanzlik's office.

Scientists research constantly to improve or design new safety equipment . . .

Tool-makers, with experienced hands, skillfully manufacture production tools . . .

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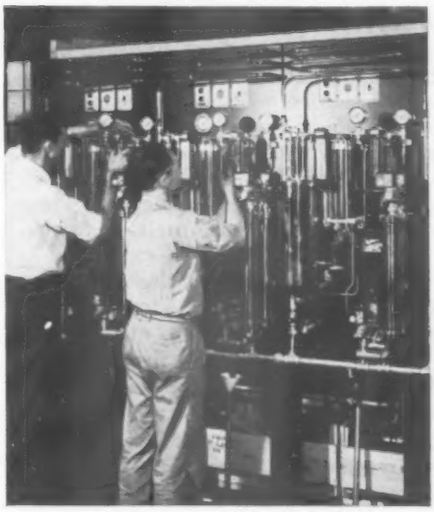

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Machinists with precision tools shape metals to meet vital tolerances . . .

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Executive Director
Military Petroleum Supply Agency

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LET's take a look at the largest single buyer of petroleum products in the world.

This petroleum supply organization is also dollar-wise the largest single manager in the military establishment, with purchase contracts amounting to more than a billion dollars each year.

As the term single manager suggests, the Military Petroleum Supply Agency, Department of the Navy, contracts for purchase and delivery of petroleum and petrochemicals for all uses within the Defense Department.

The four services: Army, Navy, Air Force and Marines, all forecast their petroleum needs to MPSA for the coming year. The aggregate totals nearly 300 million barrels of petroleum products.

These forecasts include amounts required, location for delivery, and specification of product. The MPSA is also familiar with storage and receiving facilities for incoming supplies so that actual delivery can be made.

World-wide Scope

The operation is worldwide both as to purchase and delivery. Emergencies such as have occurred in Suez, the near East and the Congo usually require the rerouting of supplies already contracted for or in transit.

In the Congo, the big need was for aviation gasoline to move commercial supplies and lift civilians out of the troubled area.

Commercial air transport coming down from Europe were fueled at Wheelus Field with enough gas to get them into Leopoldville and back out again with civilians to a base near, but outside, the Congo. The aircraft were then gassed for a short trip to the West Coast of Africa, and sent on to Wheelus.

The gasoline supplied after the stop from Leopoldville came overland into the African continent by water and rail to a temporary supply point.

The U.S. airlift to Stanleyville with troops from Ethiopia also required emergency type supplies.

These emergencies are met with help of the oil industry which is a worldwide operation in its own right.

Industry Facilities

Where possible, the government makes use of industry facilities for storage, terminals and transportation. This keeps the inventory down, and MPSA officials estimate the entire stock of military petroleum products turns over seven to eight times a year.

In other words, as long as supplies can be had from commercial sources there is little benefit to placing them in government storage at a rate faster than these supplies can be used. Normally, the military establishment carries about ten days to two weeks of supplies on hand.

There are, of course, both dispersed and underground storage facilities located outside target areas, which are kept ready for the real thing.

In some areas MPSA has leased commercial storage facilities and built others, but these tanks and terminals are operated on a lease basis, or with an operating contract by some private company. These facilities store only government owned supplies.

This practice allows quality control, an accurate inventory and the same type of service on supplies that comes from commercial sources.

Inspection of the supplies is cross-serviced and on an area basis. That is to say, if one service purchased oil or gasoline in an area assigned to another service for inspection, the inspecting service will check the product.

Military petroleum supplies at present come from four broad areas in the world. They are: the Persian Gulf, the U.S. Gulf, the Carribbean, and the West Coast.

Supplies are contracted in four broad categories. These are: bulk fuels, aviation fuels, domestic fuels, and package products.

The contracting branch of MPSA handles about five million dollars a day in contracts. MPSA makes some 2,500 contracts each year with petroleum suppliers in our 50 states, and 48 foreign countries. In the U.S. these contracts service 3,900 military consumers using different volumes and types of supplies.

Domestic Requirements

Domestic fuel requirements are measured at 31 million barrels (42 gallons per barrel) of product. In the domestic U.S. purchase and delivery go hand-in-hand. MPSA has four regions in the U.S. and there are five to six hundred contracts in force in each region at all times.

It is natural that petroleum suppliers with storage tanks at railheads or dockyard facilities also maintain their own trucks to deliver fuels and gasoline to customers in the surrounding area.

Costs of moving these fuels, outside of pipeline, is enough to limit the area which can be served by tank truck. Some of these business men are jobbers or suppliers distributing products of large companies in an area.

Gasoline and oil supplies that are bought by the military camps, post and stations allow the so-called small business man to render his best service.

Small Business

Small business accounts for between 20 and 30 percent of the total dollar volume of the domestic contracts. It amounted to more than $200 million in 1959.

The Small Business Administration has, by definition, said that a small refinery is one which employs less than 1,000 workers and has a maximum 30,000 barrels of processing capacity for crude oil daily.

This may be small potatoes in the oil business, but successful refining on this scale, should allow the owner a couple of cadillacs and his club dues without too great a worry.

MPSA encourages contracts with small business as a part of its operating policy. Small business is allowed to furnish supplies at the highest cost to the government based on contract prices with a large supplier.

AVIATION FUEL PROCUREMENT
(FY 1959 - 1960)

	Purchased on Open Market	Purchased Under Alkylation Facilities Program	Total
FY—1959			
Avgas 115/145			
Barrels	29,984,008	8,547,947	38,531,955
Dollars	$204,870,587	$59,581,791	$264,452,378
Avgas 100/130			
Barrels	5,671,928	276,870	5,948,798
Dollars	$ 37,276,994	$ 1,718,928	$ 38,995,922
FY—1960			
Avgas 115/145			
Barrels	24,272,438	6,532,551	30,804,989
Dollars	$157,496,665	$44,188,467	$201,685,132
Avgas 100/130			
Barrels	3,986,435	154,468	4,140,903
Dollars	$ 26,612,535	$ 917,457	$ 27,529,992

MAJOR PRODUCTS PROCUREMENT

FY 1959 vs FY 1960

Product	Thousands of Barrels			Thousands of Dollars		
	FY - 1959	FY - 1960	% of Change	FY - 1959	FY - 1960	% of Change
Aviation Gasoline	49,265(1)	39,324	(20.2)	$343,322	$265,953	(22.5)
Jet Fuels	122,289	126,178	3.2	454,427	471,279	3.7
Motor Gasolines	20,392	19,403	(4.8)	95,506	90,989	(4.7)
Diesel Fuels*	28,153	26,141	(7.1)	101,290	93,741	(7.5)
Navy Special	51,151	33,154(2)	(53.2)	96,902	56,487	(41.7)
Other Residuals	17,178	18,565	8.1	43,100	45,086	4.6
Kerosene	1,463	1,400	(4.3)	6,440	6,257	(2.8)
Other Bulk	1,099	94	(91.4)	8,015	4,892	(76.4)
TOTAL	290,990	264,259		$1,149,002	$1,031,684	

*Includes Other Distillates.
Does not include Package Products—$45,641,000, FY 1960; $47,048,000 FY 1959.
(1) Includes (10 M. BBLS) produced for Middle East crisis.
(2) Does not include (5.4 M. BBLS) Navy Exchange agreement.
Does not include Service Contracts.

All contracts are let to the lowest bidder.

Owners of storage tanks or other facilities and delivery trucks are classed as small business on the basis as other profitable enterprises. Organizations without refining equipment are classed as any other business.

For the past two years the purchasing division of MPSA has been working on an electronic data system for the award of domestic contracts. What they intend to do is to put all the data into an electronic computer from suppliers proposing to furnish oil and gasoline to a military installation. The machine will assess data and determine the low bidder.

Aviation Fuels

The largest procurement of petroleum products is made in the aviation branch. Requirements are for 49 million barrels of aviation gasoline and 125 million barrels of jet fuel. This jet fuel is basically kerosene, and volume requirement is increasing each year while the need for aviation gas is dropping.

It is easier to produce the kerosene, or the JP-4 type fuel, but the Navy prefers a JP-5 which has a higher quality—less volatile at high altitude—and you get less of it from each barrel of petroleum.

The peak production of aviation gasoline was probably reached in 1956 when the Alkylation Program, by which the government assured itself of high octane product, hit its stride.

(Continued on page 18)

H. A. KUHN
Consultant
Chemical & Industrial
Reports • Surveys
1426 G Street N.W.
Washington 5, D. C.

A BILLION DOLLARS PLUS

(Continued from page 17)

An orderly phasing out of these contracts is now under way, and it has been since 1959. Three of these contracts will continue to operate as private enterprises assuring an output of 5,800 barrels of aviation gas per day, and three other contracts with a capacity of 12,000 barrels per day will continue in effect, but these last three contracts will expire by 1965.

Bulk Suppliers

Purchases of bulk fuels amount to 87 million barrels. Most of this heavy fuel is purchased in the Persian Gulf, although 25 percent of these supplies are bought in the domestic U.S. Most of this product is for tanker loading and marine bunkers.

Packaged products amount to 105 million gallons of oil and solvents, also 20 million pounds of grease. These products are delivered in containers from a two-ounce can to 55-gallon drums. In dollars, these purchases amount to $46 million annually.

As for solvents, it might be well to point out that MPSA also buys an item the government nomenclature calls "paint thinner." This chemical will certainly thin paint, but it also has the same specification as cleaning fluid.

It is issued as dry cleaning fluid to military cleaning establishments overseas. MPSA prefers the cleaning fluid label as far as the supply catalog is concerned, because it would be difficult to convince cleaning establishments to use paint thinner on the uniforms.

As a matter of fact, service men use very little paint thinner anyway. Paint is mixed to specification and service men prefer to use it that way. There is some talk though that paint thinner or dry cleaning fluid works very well in cleaning grease from rifles, guns and machinery.

Domestic and Overseas

In the domestic U.S., MPSA publishes a catalog of successful bidders and the military paints each will supply. The military man looks in the listings to see who will furnish his petroleum supplies and the business man checks the same roster to find his customers.

Payment for the supplies is made by the Service that uses them.

Overseas delivery and pick-ups of supplies, however, require the careful check of a distribution branch in the MPSA. Here the use of sea-going tankers must be carefully checked. Demurrage on the big tankers can be very expensive, up to ten thousand dollars per day.

The distribution branch describes the job as taking all the service requirements and chopping them up into shiploadings—plus backhaul—and getting these supplies to the destination at the proper time.

Both producers of crude and refined normally quote prices and availability less delivery.

MPSA in its contracts for petroleum must also abide by the import quotas in its consideration for domestic needs.

In 1959, an over-supply condition in the petroleum industry worked favorably for MPSA buyers, who were able to contract the average price per barrel 36 cents less than the $4.30 paid in the previous year.

Approximately three-quarters of all petroleum items used by the Armed Forces are standardized. This effort on the part of MPSA is similar to standardization of component parts in private industry.

Industry Students

Another important function of MPSA is arranging for training by the petroleum industry of military and civilian personnel of the Defense Department Petroleum Indoctrination courses and studies in Advance Refinery Techniques have been presented jointly by various companies in the business.

The Agency is staffed by military personnel from the Services, and civilians who are employed by the government.

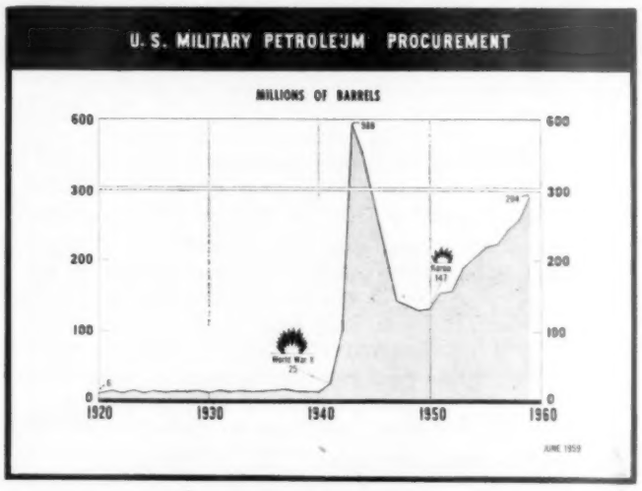
The Standard Oil Company of California, for example, has presented an indoctrination course for the 16th consecutive time. Standard of California isn't mentioned here because either they or MPSA point to this as an unusual effort. Many other companies have contributed to the general effort as well.

It just adds up to the fact that the petroleum industry and its biggest customer are working on a common problem.

FY 1960

Service	Total Net Dollar Value	Percent of Total
Air Force	$ 708,240,051	64.8
Navy*	246,478,301	22.6
Army	131,711,022	12.0
Marine Corps	6,261,691	.6
	$1,092,691,065	100.0

*Includes military and civilian agency requirements of the Federal Government in Alaska and Hawaii where commercial distribution facilities are required.



DIED

Mrs. Ivy C. Roberts, wife of Colonel O. E. Roberts, Jr., Secretary-Treasurer of A.F.C.A., as the result of injuries suffered in a fall at Annisquam, near Gloucester, Mass., while she and the Colonel were on vacation.

She was a native of Medford Hillside, Mass.

Burial was in Arlington Cemetery.

Mrs. Anna Mae Wilcox Lewis Hottel, wife of Rear Admiral M. P. Hottel, USN Retired, Vice President and Chairman of the Mobilization Planning Committee of A.F.C.A., at her home in Washington, D.C.

Mrs. Hottel was born in Panama, daughter of the U.S. Vice Consul there, Mr. Robert Wilcox.

Colonel James Sawders, USAR Retired, formerly Chemical Corps Reserve Officer who headed the Plant Protection Branch, Office of the Chief Chemical Warfare Service during World War II.

For sometime since his retirement Colonel Sawders had resided, with his wife Eunice, at Myrtle Beach, S.C.

NERVE GAS TESTS MADE FOR PRESS

Army Lifts Lid at Dugway

BRIGADIER GENERAL FRED J. DELMORE, Commanding General of the Chemical Corps Research and Development Command, opened up Dugway Proving Ground to newspapermen who wanted to know more about chemical weapons.

The reporters saw demonstrations of nerve gas, incapacitating agents, and voluntarily came into contact with a riot control gas.

Gas shells fired from 155 mm howitzers raced two miles down range and burst into a simulated machine gun nest. A pigeon in the machine gun nest was dead before the disturbance of the burst had cleared away.

Sparky, a small black dog, was placed in a gas chamber where he inhaled incapacitating gas, and was unable to move after a whiff of the gas. Sparky, who is a pet, wasn't in pain. He was quicky revived with an antidote and began to frisk around.

The riot control agent, a more powerful tear gas, had the reporters gasping and choking within seconds.

It was the first time that Dugway Proving Ground, which has an area larger than Rhode Island, has been opened to a press demonstration. It is the Army testing ground for chemical, biological, and radiological warfare.

Constant research is required to keep military defensive measures abreast with changing and newly developed weapons.

The reporters were unanimous in their opinions that chemical weapons are effective and their specific views varied from the humane, or quick-killing features of chemical weapons, to amazement at the size of the Dugway Proving Ground.

"Uncle Sam has decided to push CBR warfare for reasons of survival," Jim Lucas wrote for the Washington *Daily News*. "This reporter, whose skin still stings a bit, can say positively the Army is on the right track," Richard Fryklund wrote in the Washington *Evening Star*. "Five-year CBR R&D Plan gets JCS approval" was the headline in the Army Navy Air Force *Journal*. "Delmore said attack could come in the form of missiles, aircraft, rockets or artillery," said Phil Goulding of the Cleveland *Plain Dealer*. "The objective is to make sure that this country has offensive and defensive capabilities equal to those of any other country," wrote William Patrick in the Salt Lake City *Tribune*. Other newspapers printed similar stories.

Dr. Richard Morse, Director of Research and Development U.S. Army, asked the press to help in the need for public awareness of CBR activities.

A. F. C. A. AFFAIRS

Representative Robert L. F. Sikes (Dem-Fla) is sworn in as a Brigadier General, USAR, by the Army Adjutant General, Maj. Gen. Robert V. Lee at the Pentagon. Looking on are General Lyman L. Lemnitzer, COFS, U.S. Army (left), and Secretary of the Army Wilber M. Brucker.

Newly elected officers of the Chesapeake Chapter of A.F.C.A., Army Chemical Center, Md. From left to right: Treasurer, Mr. David Bourque; Vice President, Dr. Leo P. Brophy; Executive Vice President, Mr. John H. Fonner; President, Mr. Marvin Kahn; and Secretary, Mr. George Cole.

Lt. Col. Westbrook, the Chemical Corps Deputy Commander at Fort Detrick, has been elected President of the Fort Detrick Chapter. Other new officers are Capt. John C. Kirsch, 1st Vice President; Everett Hanel, 2nd Vice President, and Capt. William Eaton, Secretary-Treasurer.

The new officers elected by the Rocky Mountain Arsenal Chapter are: Mr. Knowles C. Clifton, President; Mr. Elmo R. Jones, 1st Vice President; Lt. Col. Lawrence M. Dellinger, 2nd Vice President; and Mr. Donald W. Eversman, Secretary-Treasurer.

★ ★ ★

Dr. Carl Robert Brewer, formerly chief of the Research Division, U.S. Army Chemical Corps Research and Development Command, Washington, D.C., has been appointed chief of the Research Grants Branch, Division of General Medical Sciences, National Institute of Health.

In his new position, Dr. Brewer will supervise the administration of the DGMS program of grants for research in the sciences basic to medicine and biology, in environmental and public health and in certain clinical sciences. The Research Grants Branch also supervises the DGMS Russian Scientific Translation Program and the Clinical Research Facilities Program.

CHEMICAL CORPS CONTRACTS SPREAD ACROSS THE NATION

The prime contractors of the Chemical Corps are located in all sections of the country the latest summary has disclosed. Contracts listed here exclude all but the prime contracts in amounts of more than $10,000. Subcontractors who may be working for or supply components to the prime contractors are omitted. Contractors are listed according to four procurement points for the Army Chemical Corps. The type of work being done under the contract has been left out on purpose, as some of the contracts or portions of some of the contracts may contain classified military information.

The large letter M stands for thousands. Here is the list:

CONTRACTS OVER 10 M BEING ADMINISTERED AS OF 30 JUNE 1960

U.S. Army Chemical Center Procurement Agency

Aerojet General Corp.	Azusa, Calif.	248 M
Aircraft Armaments, Inc.	Cockeysville, Md.	188 M
Aircraft Armaments, Inc.		138 M
Aircraft Armaments, Inc.		62 M
Aircraft Armaments, Inc.		79 M
Aircraft Armaments, Inc.		63 M
Aluminum Co. of America	Pittsburgh, Pa.	80 M
Anco Technical Writing Services, Inc.	Groton, Conn.	13 M
Applied Science Laboratories	State College, Pa.	35 M
Armour & Co.	Chicago, Ill.	99 M
Armour Research Foundation	Chicago, Ill.	124 M
Armour Research Foundation		65 M
Armour Research Foundation		30 M
Baird-Atomic, Inc.	Cambridge, Mass.	53 M
Barnes Engineering Co.	Stamford, Conn.	29 M
Battelle Memorial Institute	Columbus, Ohio	19 M
Battelle Memorial Institute		38 M
Blackmer Pump Company	Grand Rapids, Mich.	11 M
The Borden Chemical Co.	Middlesex, N.J.	150 M
Boston University	Boston, Mass.	10 M
University of California	Berkeley, Calif.	63 M
University of California		18 M
University of California		20 M
Caterpillar Tractor Co.	Peoria, Ill.	16 M
University of Chicago	Chicago, Ill.	20 M
University of Chicago		24 M
Clarkson College of Technology	Potsdam, N.Y.	35 M
College of Medical Evangelists	Lomo Linda, Calif.	247 M
University of Colorado	Denver, Colo.	37 M
University of Connecticut	Storrs, Conn.	26 M
University of Connecticut		20 M
Container Laboratories, Inc.	Washington, D.C.	51 M
Continental Rubber Works	Erie, Pa.	50 M
Controls for Radiation, Inc.	Cambridge, Mass.	115 M
Cook Electric Co.	Morton Grove, Ill.	472 M
University of Delaware	Newark, Del.	24 M
University of Delaware		8 M
Delsea Iron Works	Millville, N.J.	13 M
Documentation, Inc.	Washington, D.C.	18 M
Eastman Kodak Company	Rochester, N.Y.	154 M
Edo Corporation	College Pt., L.I., N.Y.	126 M
Edo Corporation		119 M
Electronic Communications, Inc.	Timonium, Md.	38 M
Farrand Optical Co., Inc.	New York, N.Y.	320 M
Farrand Optical Co., Inc.		15 M
Farrand Optical Co., Inc.		44 M
Food Machinery & Cml Corp.	Baltimore, Md.	400 M
Fordham University	New York, N.Y.	20 M
Franklin Institute	Philadelphia, Pa.	79 M
General Development Corp.	Elkton, Md.	
General Mills, Inc.	Minneapolis, Minn.	25 M
George Washington University	Washington, D.C.	237 M
Gulton Industries, Inc.	Metuchen, N.J.	233 M
Harris Research Labs., Inc.	Washington, D.C.	55 M
Harris Research Labs., Inc.		64 M
Harvard College	Cambridge, Mass.	50 M
Hazleton Laboratories, Inc.	Falls Church, Va.	120 M
Johns Hopkins University	Baltimore, Md.	101 M
Johns Hopkins University		18 M
Johns Hopkins University		28 M
University of Illinois	Urbana, Ill.	23 M
Indiana University Foundation	Bloomington, Ind.	30 M
Iowa State University of Science & Technology	Ames, Iowa	33 M
Corydon M. Johnson Co., Inc.	Bethpage, N.Y.	21 M
M. W. Kellogg Co.	New York, N.Y.	638 M
The Lankenau Hospital	Philadelphia, Pa.	35 M
D. H. Litter, Inc.	New York, N.Y.	48 M
Arthur D. Little, Inc.	Cambridge, Mass.	63 M
Arthur D. Little, Inc.		25 M
Arthur D. Little, Inc.		55 M
Machinery Associates, Inc.	Wynnewood, Pa.	11 M
Mapp Contracting Company	Baltimore, Md.	213 M
University of Maryland School of Medicine	Baltimore, Md.	123 M
University of Maryland	College Park, Md.	91 M
University of Maryland	Baltimore, Md.	100 M
University of Maryland	College Park, Md.	30 M
University of Maryland	Baltimore, Md.	25 M
Massachusetts General Hospital	Boston, Mass.	15 M
S. P. Mehring	Hanover, Pa.	22 M
Melpar, Inc.	Falls Church, Va.	63 M
Melpar, Inc.		299 M
Mine Safety Appliances Co.	Pittsburgh, Pa.	199 M
University of Mississippi	Jackson, Miss.	19 M
The M & T Company	Philadelphia, Pa.	96 M
The M & T Company		180 M
MTD Research & Development	Timonium, Md.	24 M
Monsanto Chemical Co.	Boston, Mass.	50 M
New England Institute of Medical Research, Inc.	Ridgefield, Conn.	39 M
New Mexico College of A & M.	State College, N.M.	117 M
New York University	New York, N.Y.	60 M
New York University		63 M
New York University		24 M
New York University		36 M
Nuclear-Chicago Corp.	Silver Spring, Md.	16 M
Nuclear Development Corp.	White Plains, N.Y.	103 M
Olin Mathieson Chemical Corp.	East Alton, Ill.	56 M
Operations Research, Inc.	Silver Spring, Md.	112 M
University of Pennsylvania	Philadelphia, Pa.	76 M
University of Pennsylvania		35 M
University of Pennsylvania		35 M
University of Pennsylvania		30 M
University of Pennsylvania		14 M
Pittsburgh Coke & Cml Co.	Pittsburgh, Pa.	50 M
University of Pittsburgh	Philadelphia, Pa.	50 M
Polytechnic Institute of Brooklyn	Brooklyn, N.Y.	41 M
Polytechnic Institute of Brooklyn		12 M
R & K Contractors	Baltimore, Md.	63 M
Radio Corp. of America	Camden, N.J.	386 M
Renner, Incorporated	Philadelphia, Pa.	11 M
Renner, Incorporated		11 M
Riegel Paper Corporation	New York, N.Y.	145 M
Riegel Paper Corporation		44 M
Riker Laboratories, Inc.	Northridge, Calif.	41 M
University of Rochester	Rochester, N.Y.	22 M
Royer and Roger, Inc.	New York, N.Y.	131 M
Rutgers, The State University	New Brunswick, N.J.	58 M
S & H Contracting Company	Baltimore, Md.	42 M
S & H Contracting Company		28 M
Sciaky Brothers, Inc.	Chicago, Ill.	297 M
George H. Schuman Co., Inc.	Baltimore, Md.	170 M
Sciaky Brothers, Inc.	Chicago, Ill.	11 M
Southern Research Institute	Birmingham, Ala.	73 M
Space Corporation	Dallas, Texas	130 M
Stanford Research Institute	Stanford, Calif.	35 M
Stanford Research Institute		30 M
Syracuse University	Syracuse, N.Y.	27 M
Temple University	Philadelphia, Pa.	12 M
Texas A & M Research Foundation	College Station, Texas	25 M
C. F. Traugott & Son	San Antonio, Texas	14 M
Tyler Refrigeration Corporation	Niles, Mich.	12 M
U.S. Testing Company, Inc.	Hoboken, N.J.	68 M
U.S. Testing Company, Inc.		31 M
U.S. Testing Company, Inc.		67 M
Vanderbilt University	Nashville, Tenn.	24 M
Virginia Institute for Scientific Research	Richmond, Va.	27 M
University of Washington	Seattle, Wash.	137 M
University of Washington		18 M
Western Reserve University	Cleveland, Ohio	30 M
Westinghouse Electric Corporation	Baltimore, Md.	53 M
University of Wisconsin	Madison, Wis.	34 M
University of Wisconsin		20 M
Woodard Research Corporation	Herndon, Va.	49 M
World Life Research Institute	Colton, Calif.	15 M
Yale University	New Haven, Conn.	20 M

U.S. Army Chemical Procurement District, New York

Acushnet Process Co.	New Bedford, Mass.	152 M
Acushnet Process Co.		486 M
Allstate Can Corporation	Clifton, N.J.	72 M
Amcel Propulsion Inc., Div. of Celanese Corp. of America	New York, N.Y.	145 M
American Chemsol Corporation	Coraopolis, Pa.	10 M
AMPCO Manufacturing Co.	Plainfield, N.J.	12 M
A. C. Ball	San Carlos, Calif.	97 M
Barkey Importing Co., Inc.	New York, N.Y.	115 M
Boeing Airplane Company	Wichita, Kans.	623 M
Brothers Chemical Company	Orange, N.J.	51 M
Brothers Chemical Company		179 M
Brothers Chemical Company		94 M
Brothers Chemical Company		64 M
Brothers Chemical Company		137 M
Cabel Electric Products	Providence, R.I.	15 M
Chemical Compounding Corp.	Brooklyn, N.Y.	28 M
Chrysler Corporation	Detroit, Mich.	40 M
Columbia-Southern	Pittsburgh, Pa.	348 M
Herbert Cooper Co.	Genesee, Pa.	24 M
Curtis Automotive Devices	Westfield, Ind.	37 M
E. I. du Pont	Wilmington, Del.	10 M
Dye and Chemical Div. General Aniline & Film Corp.	New York, N.Y.	22 M
Eastern Canvas Products	Haverhill, Mass.	46 M
Federal Labs, Inc.	Saltsbury, Pa.	84 M
Geuder-Paeschke & Trey Co.	Milwaukee, Wis.	237 M
Great Lakes Rubber Corp.	Hamburg, N.Y.	40 M
General Motors	Detroit, Mich.	163 M
General Tire & Rubber Co.	Wabash, Ind.	47 M
General Tire & Rubber Co.		34 M
General Tire & Rubber Co.		405 M
General Tire & Rubber Co.		28 M
General Tire & Rubber Co.		273 M

R. M. Hollingshead	Camden, N.J.	88 M
H. D. Hudson Manufacturing Co.	Detroit, Mich.	40 M
Kay-Fries Chemicals, Inc.	New York, N.Y.	10 M
Kilgore, Incorporated	Westerville, Ohio	79 M
Arthur S. LaPine	New York, N.Y.	25 M
Leeds & Northrup	Philadelphia, Pa.	36 M
Longines-Wittnauer Watch Co.	New York, N.Y.	444 M
Midland-Ross Corp., J. Anitrol Aircraft Div.	Columbus, Ohio	133 M
Mine Safety Appliances	Pittsburgh, Pa.	98 M
Mine Safety Appliances		3134 M
Mine Safety Appliances		26 M
Mirax Chemical Products	St. Louis, Mo.	159 M
Norris-Thermador Corp.	Los Angeles, Calif.	289 M
Norris-Thermador Corp.		3705 M
Norris-Thermador Corp.		401 M
Olin-Mathieson Corp.	East Alton, Ill.	50 M
Ordnance Products	Elkton, Md.	144 M
Ordnance Products		151 M
Ordnance Products	Northeast, Md.	94 M
The Polycast Corp.	Stamford, Conn.	41 M
Proctor & Schwartz		91 M
Remsel Industries, Inc.	Chicago, Ill.	68 M
Remsel Industries, Inc.		124 M
B. F. Reif Co., Inc.	Philadelphia, Pa.	154 M
Small Motors, Inc.	Chicago, Ill.	478 M
Scoville Manufacturing Co.	Waterbury, Conn.	63 M
Security Signals, Inc.	Cordova, Tenn.	27 M
Shwayder Brothers, Inc.	Denver, Colo.	561 M
Standard Pyroxoloid Corp.	Leominster, Mass.	29 M
Van Brode Milling, Inc.	Clinton, Mass.	22 M

U.S. Army Chemical Corps Proving Ground, Dugway Proving Ground

University of Utah (8 contracts)	Salt Lake City, Utah	1570 M
Stanford University	Stanford, Calif.	766 M
Utah State University	Logan, Utah	30 M
General Analysis Corp.	Los Angeles, Calif.	289 M
Meteorology Research	Altadena, Calif.	95 M
Barrett & Craven	Northbrook, Ill.	32 M
Tracer Laboratories	Richmond, Calif.	19 M
White Rubber Company	Ravenna, Ohio	13 M
Jalbert Laboratories	Boca Raton, Fla.	13 M
Arden Dairies	Salt Lake City, Utah.	30 M
Utah Power & Light	Salt Lake City, Utah.	150 M
TelePrompter Corporation	New York, N.Y.	12 M
Motor Lease, Inc.	Salt Lake City, Utah.	17 M
Mollerup Van Lines	Salt Lake City, Utah.	19 M
Remington Rand	Salt Lake City, Utah.	24 M
Ajax, Inc.	Tooele, Utah	18 M
Eagle Laundry	Salt Lake City, Utah.	19 M
Standard Builders	Salt Lake City, Utah.	25 M
Western States Refining	Salt Lake City, Utah.	122 M
Utah Oil	Salt Lake City, Utah.	19 M
Intermountain Oil	Bountiful, Utah	20 M
Utah-Idaho Roofing	Salt Lake City, Utah.	13 M
W. F. Ludington	Salt Lake City, Utah.	15 M

U.S. Army Chemical Corps District, San Francisco

Federal Laboratories	Saltsburg, Pa.	17 M
Nuodex Products Co.	Elizabeth, N.J.	16 M
West Virginia Pulp & Paper Co.	New York, N.Y.	24 M
Metimpex Corp.	New York, N.Y.	10 M
Octagon Process Co.	Edgewater, N.J.	62 M
Free State Supply Co.	Washington, D.C.	15 M

U.S. Army Chemical Corps Biological Laboratories, Fort Detrick, Md.

Boone Wood Products	Baltimore, Md.	21 M
Charleston Rubber Co.	Charleston, S.C.	36 M
Chemical Rubber Co.	Pittsburgh, Pa.	11 M
County Floor Service	Mt. Airy, Md.	25 M
Eastwood Painting Co., Inc.	Baltimore, Md.	10 M
Ford Construction Co.	Frederick, Md.	12 M
General Electric Co. (Lamp Div.)	Baltimore, Md.	25 M
County Floor Service	Mt. Airy, Md.	25 M
General Electric Supply Co.	Hagerstown, Md.	12 M
Grevey & Grady, Inc.	Baltimore, Md.	12 M
M. J. Grove Lime Co.	Lime Kiln, Md.	13 M
Edwin H. Harrison	Woodbine, Md.	10 M
Hess, Incorporated	Baltimore, Md.	17 M
Hess, Incorporated		13 M
Horner Elevator Co., Inc.	Washington, D.C.	39 M
M. S. Johnson Co., Inc.	Hagerstown, Md.	18 M
D. Lee Keller	Brunswick, Md.	124 M
D. Lee Keller		12 M
Richard F. Kline, Inc.	Frederick, Md.	14 M
Lab Tek Plastics Co., Inc.	Westmont, Ill.	20 M
Miller-Liskey Electric Co., Inc.	Hagerstown, Md.	20 M
E. Stewart Mitchell, Inc.	Baltimore, Md.	13 M
J. D. Mullican Co.	McMinnville, Tenn.	11 M
Opelika Welding, Machine & Supply, Inc.	Opelika, Ala.	11 M
Remington Rand	Washington, D.C.	14 M
Remington Rand		18 M
T. Edgie Russell, General Contractor, Inc.	Frederick, Md.	13 M
Seal & Co.	Washington, D.C.	16 M
George F. Shaw	West Chester, Pa.	74 M
Thurmont Construction Co.	Thurmont, Md.	16 M
Tristate Electrical Supply Co.	Hagerstown, Md.	10 M
Westinghouse Electric Corp.	Washington, D.C.	10 M
Westinghouse Electric Supply Co.	Baltimore, Md.	10 M
Worthington Corporation	Harrison, N.J.	46 M
Aerojet-General Corp.	Azusa, Calif.	148 M
Aerojet-General Corp.		533 M
American Electronics, Inc.	Culver City, Calif.	22 M
Armour Research Foundation of Illinois Institute of Technology	Chicago, Ill.	190 M
Associated Nucleonics, Inc.	Garden City, N.Y.	308 M
Booz-Allen Applied Research, Inc.	Chicago, Ill.	1172 M
Bowen Engineering, Inc.	North Branch, N.J.	161 M
Brooklyn College	Brooklyn 10, N.Y.	14 M
University of Chicago	Chicago, Ill.	97 M
University of Chicago		180 M
Douglas Aircraft Co.	Santa Monica, Calif.	661 M
Duke University	Durham, N.C.	53 M
Fairchild Engine & Airplane Corp.	Hagerstown, Md.	12 M
General Mills, Inc.	Minneapolis, Minn.	119 M
George Washington University	Washington, D.C.	672 M
George Washington University		530 M
General Analysis Corp.	Los Angeles, Calif.	63 M
Johns Hopkins University	Baltimore, Md.	839 M
University of Illinois	Urbana, Ill.	12 M
Kansas State College	Manhattan, Kans.	55 M
University of Maryland	College Park, Md.	107 M
Massachusetts Institute of Technology	Cambridge, Mass.	161 M
Merck & Co., Inc.	Philadelphia, Pa.	38 M
Regents of University of Michigan	Ann Arbor, Mich.	14 M
Mine Safety Appliances Co.	Pittsburgh, Pa.	30 M
Mine Safety Appliances Co.		29 M
University of Minnesota	Minneapolis, Minn.	63 M
University of Minnesota		26 M
National Academy of Sciences	Washington, D.C.	22 M
National Research Corp.	Cambridge, Mass.	134 M
North American Aviation, Inc.	Los Angeles, Calif.	304 M
Ohio State University Research Foundation	Columbus, Ohio	245 M
Photomechanisms, Inc.	Huntington Sta., N.Y.	76 M
Planning Research Corp.	Los Angeles, Calif.	75 M
University of Pennsylvania	Philadelphia, Pa.	287 M
University of Pennsylvania		471 M
Polaroid Corporation	Cambridge, Mass.	66 M
Rutgers, The State University	New Brunswick, N.J.	47 M
Southern Research Institute	Birmingham, Ala.	35 M
Southern Research Institute		46 M
Leland Stanford Jr. University	Stanford, Calif.	232 M
Stanford Research Institute	Menlo Park, Calif.	45 M
University of Texas (Southwestern Med. Sc.)	Dallas, Texas	47 M
University of Texas	Austin, Texas	12 M
University of Utah	Salt Lake City, Utah.	21 M
University of Wisconsin	Madison, Wis.	96 M
Wistar Institute of Anatomy & Biology	Philadelphia, Pa.	42 M
Motion Picture Service	Washington, D.C.	51 M
Motion Picture Service		11 M
National Bureau of Standards	Washington, D.C.	250 M
Technical Branch, Communicable Disease Ct.	Atlanta, Ga.	132 M
Robert A. Taft Engineering Center	Cincinnati, Ohio	155 M
Robert A. Taft Engineering Center		34 M
Dept. of Health, Education & Welfare	Atlanta, Ga.	60 M

INDUSTRIAL COLLEGE OFFERS STUDY COURSE IN ECONOMICS

The Armed Forces Industrial College is offering a graduate-level course of correspondence study on The Economics of National Security.

This course consists of five integrated units of study: background information, resources and facilities, processes in the economics of national security, foreign aspects of national security, and the problems of national security.

These studies are based on the resident course, of ten-months duration, conducted by the Industrial College at Fort Lesley J. McNair, Washington, D.C. The correspondence version usually requires a year to complete.

Qualified students for this course of study include: military officers of all components of the Department of Defense and the Coast Guard, serving on active or inactive status in the grade of major or lieutenant commander or higher. Also included are all civilian federal employees with GS-11 rating, or higher. A college education or its equivalent is highly desirable.

All applicants are considered on individual merits.

A certification is issued to all who satisfactorily complete the course, and reports of completion are submitted to proper authorities so that this information may be included in personnel records.

The Industrial College, under direction of the Joint Chiefs of Staff, conducts course of study in economic and industrial aspects of national security to enhance the individual's preparation for important command, staff, and policy-making positions in the national security structure.

Those interested in the course may apply to the Commandant, Industrial College of the Armed Forces, Washington 25, D.C., Attn: Correspondence Course Division.

PROTRACTED CONTRACT

(Continued from page 10)

only we who have failed: Western society as a whole has failed.

It is because of that failure, and because of that failure alone, that Lenin and his heirs have been able to steal a march on us to transform the strategic situation and keep us, to this day, immobilized in our own preconceptions. Is this too harsh a verdict?

Where were we in 1945? We stood at the very height of our power. At that time all nations except the United States were defeated, our foes and our allies alike. Germany and Japan had been knocked out. Surely, Italy no longer mattered as a great power, if she ever had. The Soviet Union was flat on its back, having suffered 20 million casualties and the destruction of most of its industrial plant situated in European Russia.

We were the one power that, at that time, could have transformed the order of the world to our own specifications. There was no one, friend or foe alike, who could have stopped us in whatever course we might have chosen.

Political Problems

All our problems at that time were problems of internal politics, and these problems in turn stemmed, I repeat, and you may feel that I repeat it *ad nauseum*, from the failure to grasp intellectually the world political realities around us.

Certainly, we possessed an abundance of the physical resources. We held the monopoly of atomic weapons. We were the one people that had not been hurt by war and that at the end of the war was much stronger than it had been at its start. The United States was the one country that still could bring all its resources to bear upon the remaking of the world order. We could have created a new international system and closed the systemic revolution.

We failed. If the last 15 years would have been 15 years of hot and not cold war and if the general staffs of the Western Allies were to assemble today in order to evaluate the situation on the basis of positions won or lost, they would agree that we have suffered defeat upon defeat and an alarming deterioration of our strategic over-all situation.

No Real Peace

It is only because we supposed the war to have been "cold," because we told ourselves that, except for some passing and localized conflicts, we were at peace, and because we argued about the more or less remote possibility of a third world war although we were in the midst of it, that we cannot even today recognize clearly how disastrous has been our strategic retreat and how grave have been our defeats.

Thus far I have spoken of our intellectual failure to grasp the nature of the systemic revolution, to develop the techniques that are necessary in order not only to survive as a nation but to create that new order which alone can guarantee the continuity of our civilization. I have spoken of failure, of defeat. Let me say a few words as to what I believe still can be done to halt the communist offensive and gain the initiative. No sane and reasonably well-informed man nurtures any longer optimistic expectations about the immediate prospects ahead of us. No one among us believes that what is ahead of us will be easy. At best, this generation will have to pay for its errors with sweat and tears; we can only hope that it will not have to pay with a heavy tribute of blood.

No one among us believes that the tasks before us can be carried out otherwise than by enormous effort, heavy economic sacrifice, and by staking our lives.

Clear Thinking

Yet, most certainly, all is not lost. We hold almost everything in our hands that is needed in order to prevail over our enemies. We can work our salvation if we only begin to think straight, draw the proper conclusions and translate our intellectual understanding into the workings of our nation, of its foreign and security policies, of its plants, of its schools and, most importantly, its morality.

We like to speak of ourselves as a great nation. Indeed, in many ways we are a great people. We are great in our productivity. We are great in the burst of creative imagination which has brought forth all the mechanical wonders around us, the fabulous gadgetry luxuries of our daily lives, and the physical means whereby we are extending our mastery over nature.

The true greatness of a nation is not in its wealth nor in the might of its arms. The true greatness of a nation lies in its ability to identify itself with the aspirations of mankind.

This truth the leaders of this nation knew at the time of the Revolution. This awareness of the aspirations of mankind—aspirations that transcend national interest—speaks to us through the statements of the great men in American history.

Task Ahead

Today, the aspirations of mankind are not a mystery. They are quite clear: The task is to bring order out of disorder, settle the systemic revolution and replace an outworn state system with a new state system that will insure political stability and give mankind peace and thus the chance to tackle, untroubled by fear, its economic and social problems.

The one and only question is: In whose image is that new universal order to be created? In theirs or ours?

Will that order be the order of the totalitarian state, or will that order be transformed in our image, the open society of free men?

Let me repeat the question is not one of national survival, for today there is no such thing as national survival. There is only survival through, so to speak, sublimating our national interest—by putting our national forces to work on the behalf not only of ourselves but of all men to whom we are inseparably tied by the strands woven by the technological, industrial and scientific revolution.

Greatness Achieved

Nations that achieved greatness achieved it because they associated themselves with the aspirations of mankind. Rome was great not only because of the valor of her legions, but because her military power served to establish universal justice, order and peace.

Britain, upon the Battle of Trafalgar, achieved greatness not because she had conquered Napoleon and was the dominant sea power of the age, but because British sea power guaranteed the freedom of commerce to all peoples and because the British balance-of-power policy gave mankind a century of peace.

Now the mantle of Britain has fallen upon our shoulders. It is we who must offer mankind something beyond our determination to defend ourselves and our allies—a determination to which, if we are not bereft of sense, we must stick to anyway. And we have something to offer beyond mere survival. We have to offer exactly what mankind needs, to wit, our federative idea.

The present contest is a contest between two federative ideas. There is the federative idea of the communist block, i.e. a federation imposed from above by a ruling minority responsible to no one and kept together by

naked power. By contrast, we look back upon a history of voluntary federation—federation by consent and compromise. The development of our federative institutions has been haphazard, for nothing that happens in a democracy is ever systematic or symmetrical. A measure of inefficiency and waste is inseparable from representative government. But our federative experiment has succeeded far beyond the expectations of its originators. We have achieved a unique balance between federal power and local autonomy.

Age of Federation

We have shown the world how to federate: Out of 13 there have come 50. It is this achievement and the ideals to which it pays homage, that we can hold up to mankind as a token of our capacity for leadership in the making of wider union.

The age of federation has already begun. In Europe, old nation states are surrendering increasingly large portions of their sovereignty to new federative organizations—to such permanent, standing treaty organizations as, for example, Western Union, to functional federations such as the European Coal and Steel Community, the European Common Market, and EURATOM.

We ourselves have surrendered part of our national sovereignty to such informal federative organizations, as for example the North Atlantic Treaty Organization and the Organization of American States.

True enough, these are fragmentary or embryo federations. But the trend is clear. The forces of change are moving in this direction. All history asks of us is to structure the revolutionary forces that are on the loose throughout the world and which, because we are not putting them to creative work, are being increasingly used by our communist adversary for destructive purposes. These forces are universal.

Unhappy Nations

You can see in Africa, that dismal, unhappy continent, how the peoples are clutching at an obsolete state form, namely national sovereignty, and how quickly, upon obtaining that meaningless distinction, they are seeking to enter larger associations to satisfy the real needs of their peoples. The tragedy is that these new nation-states ape a concept of political existence which they inherited from the West but which no longer accords with the real requirements of the times.

Most of the new nations of Asia and Africa really are not nations; they are sovereignties in name only but incapable of exercizing the power of sovereignty. They bask in the reflected glory of formal sovereignty attested by a seat in the United Nations, ornate and expensive embassies, and a colorful national flag. In fact, this kind of national sovereignty is pure fiction. Because of the lag in our thinking or mere inertia we have encouraged this fiction. We have supported concepts of national sovereignty that were quite appropriate in the 19th century, but that no longer are meaningful under modern conditions.

A difficult and displeasing task confronts us: We have to face ourselves and examine the validity of our dearest slogans. National self-determination is *not* a supreme good under all and any conditions. We have to tell many peoples throughout the world that now they cannot and should not have what we ourselves once thought was good for them, for times have changed and the political ideals of the 19th and the early 20th century, especially that of national self-determination, must be reconciled to present-day realities.

U. S. Must Lead

If it is we who have to lead mankind into a new universal order, then we must begin to unite what can be united. What can be united *now* is what is already in the process of being united, albeit without unitary direction and purpose.

The North Atlantic Community exists. It is a community of like-minded peoples, rooted in Graeco-Roman, Judaeo-Christian civilization. The North Atlantic Treaty Organization represents the first—and thus far the one and only—step in the development of a federative framework for the North Atlantic Community. Its primary mission is common defense. Our task is now to breathe new life into the North Atlantic Treaty Organization—to strengthen it not only militarily but also by increasing, in accordance with Article 2 of the North Atlantic Pact, its authority in the field of political, economic and cultural cooperation.

To transform NATO into a wider union will require not only great diplomatic skill but also the willingness to accept specific restrains on our national sovereignty.

Need For Authority

No one expects that NATO can be turned into a federation on the tight U. S. model overnight. But there is a pressing need for the establishment of a federative authority in the limited fields of common security and foreign policies and common economic policies towards the communist bloc and underdeveloped countries.

The making of a wider Atlantic Union is only the first, though essential step towards the union of all free peoples. The making of such a union, this is our historic mission. Its execution will constitute our claim to greatness.

Leadership in this endeavor is fraught not only with political and economic risks but also with mortal danger: For the contest between the two federative ideas—the communist and ours—is irreconcilable. We cannot appease the communists armed with their exclusive formula for settling the systemic revolution.

There can be no compromise. There will be no convergence of ideologies. There will be a protracted struggle in which total nuclear war will be always a contingency. In that protracted conflict, cold war and nuclear war cannot be separated from one another. The conflict between the free peoples and the communist bloc is an organic whole. Its spectrum ranges all the way from political warfare and propaganda across the sector of limited war to total nuclear war. The risk of total war is inherent in the historic situation. No amount of discussion or negotiation can remove it. To that extent, the execution of our mission calls for not only the mobilization of our intellectual and physical resources but also the willingness to stake each day our lives. We cannot win the future except by wagering ourselves.

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DEFENSE SUPPORT OF CHEMICAL RESEARCH

Dr. Herbert F. York, Director of Defense Research and Engineering Office of the Secretary of Defense

Basic chemical research supported by the Department of Defense at the present time includes work on molecular structure and physical properties of compounds, plastice and polymers, inorganic and analytical chemistry, and energy transfer processes, to mention only a few areas.

Information available in the Office of the Director of Defense Research and Engineering, headed by Dr. Herbert F. York, indicates that basic research in the various areas of chemistry is currently being supported by the Military Departments with expenditures of some 8 million dollars for this fiscal year.

Planning for basic research in chemistry is accomplished by the Office of Science, which is a staff office in Dr. York's activity, representatives of the Military Departments, and an Advisory Panel on General Sciences composed of prominent U.S. scientists.

Chairman of this advisory panel is Dr. Robert W. Cairns, Vice President and Director of Research of the Hercules Powder Company, who serves with other scientists from industry and universities in an advisory group to the Office of Science on basic research in 14 fields of science, chemistry being one of these.

The Services are represented in the planning stages of the chemistry program by Dr. S. J. Magram (Army), Dr. L. W. Butz (Navy), and Dr. J. A. Bierlein (Air Force), who work in conjunction with Dr. Harold C. Weber, Chief Science Advisor (Army), Dr. Thomas Killian, Chief Scientist (Navy), Dr. Alexander Flax, Chief Scientist (Air Force), and members of the Office of Science.

Staff members in the Office of Science emphasized that they are concerned with the planning *for a chemical research program*, and that the planning and direction *of the research* should properly be the responsibility of the individual scientist.

Continuing problems of basic research in chemistry, as well as in other areas of basic research, are to insure that the support levels are adequate, are reasonably free of frequent and large fluctuations, achieve an equitable balance with development programs, and that there is continuity in the program. Basic research is, of course, essential to provide a foundation for the long-range improvement of military technology that will provide the United States with adequate defensive and offensive strength.

Support of basic chemical research by the military establishment is also important to assure a continuing, intimate contact between defense R&D personnel and the Nation's scientific community. Such contact permits rapid interchange of new thought between scientists, and history has proven that this interchange also enhances the ability of the U.S. scientific community to respond quickly to the solution of specific military problems in times of emergency.

A staff member from the Office of Science elaborated for the ARMED FORCES CHEMICAL JOURNAL on a few of the chemical research areas of interest to the Defense Department as follows:

"The preparation and definitive measurement of the physico-chemical properties of ultra. pure chemicals should be emphasized. Research in this area may be one of the most promising avenues for achieving significant improvement in material properties. Deficiencies in this area have been identified to include the lack of facilities for the production of high quality single crystals and well-characterized, high purity materials for research purposes; the inability to achieve high orders of purity; and the inability to achieve sufficient precision in analytical methods to characterize and classify really pure substances.

"The preparation of new inorganic, metallo-organic, and aromatic high polymers, including the determination of their properties and the changes resulting therein from extremes of temperature, pressure, radiation and/or the action of environmental constituents will require considerable defense effort during the next few years. Polymeric materials having an extensive array of properties and conceivably useful as ablative materials, lubricants, structural materials, propellants, and/or for coatings resistant to radiation effects or to chemical reactions will be required by the Military Departments during the next few years.

"Additional basic research on polymers should be initiated as soon as competent research teams become available to help insure a sufficient variety of new polymers and the availability of adequate fundamental knowledge concerning them.

"Additional emphasis for research on hydro-boron chemistry appears especially important at this time since we may be on the threshold of extremely rapid developments useful for thermally stable polymers. Other promising approaches to the problem of thermal stability include the syntheses of aromatic high polymers, and the incorporation of selected groups of elements into the organic molecule.

"The chemistry of substances under extremes (high and low) of temperature and pressure should continue to receive considerable defense effort and support. Important factors contributing to this emphasis on high temperature chemistry are the extension of the available temperature range by the use of arc image furnaces or plasma jets. From this research may come an improved understanding of structure and bond characteristics, more accurate identification of species existent at these temperatures, and improved knowledge of the rates, mechanisms, and instabilities associated with high tempertaure reactions.

"At the extremely low temperatures, chemical and physical and electrical phenomena occur which are unique and which reflect fundamental properties often masked by molecular motions at higher temperatures. Studies of superconductivity, slowed reactions of atoms and free radicals, surface effects significant in adhesion and catalysis, and the electronic properties of atoms and radicals, using modern instrumentation and cryogenic equipment should be undertaken.

"Crystal structure determination by x-ray and electron diffraction methods, molecular and radical structure determinations by nuclear magnetic resonance or electron spin resonance techniques, and measurements of rates of formation and bond energies of radicals and molecules should be conducted at temperatures near absolute zero in an effort to obtain data applicable to the solution of problems involved in systems at higher temperatures.

(Continued on page 27)

SINGLE MANAGER TO BUY PAINT PRODUCTS FOR DEFENSE

Beginning this October, the Military Industrial Supply Agency becomes the single manager for Armed Forces purchases of paints, thinners, brushes, and allied products of the paint industry. Some 3,500 separate items in these categories go under the single manager system.

Dollar volume of these purchases is expected to run more than $26 million.

Among the services, the Navy is the largest user of paints, requiring some $16.5 million worth each year. In the other services, the Army uses $5.2 million of these products, while the Air Force paints to the tune of $3.4 million, and the Marines use $0.5 million worth of paint supplies.

The largest users in the defense structure are the Navy's shipyards and industrial plants. Here ships must be painted and metals treated against corrosion of the salt water.

The Army and the Air Force use the bulk of their paints on vehicles and airplanes. All services have buildings and permanent posts, air bases, or shore establishments to care for and maintain.

Actual purchases will be made through the General Stores Supply Office of the Navy at 700 Robbins Avenue, Philadelphia.

The following companies have supplied paint to the Navy in the past, and it is expected that these firms, along with companies who have been supplying the Army and Air Force, will now do business with MISA.

Here is a list of Navy contractors:

The Akron Paint & Varnish Co. ..... Akron, Ohio
Allied Paint Mfg. Co., Inc. ..... Landsdale, Pa.
Alsamite Paint Co. ..... Philadelphia, Pa.
American Marine Paint Co. ..... San Francisco, Calif.
Ampruf Paint Co., Inc. ..... El Monte, Calif.
Archer-Daniels-Midland Co. ..... Midland, Mich.
Asco Products Corp. ..... Nixon, N.J.
C. M. Athey Paint Co. ..... Baltimore, Md.
Atlas Paint & Varnish Co. ..... Irvington, N.J.
Automotive Finishes, Inc. ..... Detroit, Mich.
The Avondale Co. ..... Northfield, Ill.

Baltimore Copper Paint Co. ..... Baltimore, Md.
Baltimore Paint & Chemical Corp. ..... Baltimore, Md.
Better Finishes & Coatings, Inc. ..... Newark, N.J.
Bisonite Co., Inc. ..... Buffalo, N.Y.
George C. Borthig Co., Inc. ..... Rutherford, N.J.
Brooklyn Paint & Varnish Co., Inc. ..... Brooklyn, N.Y.
Andrew Brown Co. ..... Los Angeles, Calif.
Bruning Brothers, Inc. ..... Baltimore, Md.

Cadar Paint Corp. ..... Baltimore, Md.
Carroll Ltd., Inc. ..... Philadelphia, Pa.
Color Craft Corp. ..... Baltimore, Md.
Congress Paint Mfg. Co., Inc. ..... Beltsville, Md.
Consolidated Chemical & Paint Mfg. Co. ..... Brooklyn, N.Y.

Delchem Div., Pennsalt Chemical Corp. ..... Philadelphia, Pa.
De Soto Chemical Coatings Inc. ..... Philadelphia, Pa.
Devoe & Raynolds Co. ..... Newark, N.J.
Doidge-Koren Paint Co. ..... San Francisco, Calif.
Dolphin Paint & Varnish Co. ..... Toledo, Ohio

Enmar Inc. ..... Wichita, Kans.

Fiberboard Paper Products Corp. ..... San Francisco, Calif.
Benjamin Foster Co. ..... Philadelphia, Pa.
W. P. Fuller & Co. ..... San Francisco, Calif.

General Electric Co. ..... Philadelphia, Pa.
The Glidden Co. ..... Reading, Pa.

Harley Soap Co. ..... Philadelphia, Pa.
Hoboken White Lead & Color Works ..... Hoboken, N.J.
Hub Paint & Varnish Co. ..... Long Island City, N.Y.

Illinois Bronze Powder Co. ..... Chicago, Ill.
Industrial Chemical Co. ..... Berkeley, Calif.
Inter-Coastal Paint Corp. ..... Baltimore, Md.

Jaegle Paint & Varnish Co. ..... Philadelphia, Pa.

Lasting Products ..... Baltimore, Md.
Lawter Chemicals, Inc. ..... Chicago, Ill.
Lenoir Wood Finishing Co. ..... Lenoir, N.C.
Lyle Van Patten Co. ..... Gardena, Calif.

Magic Chemical Co. ..... Brockton, Mass.
Midland Adhesive & Chemical Corp. ..... Ferndale, Mich.
Benjamin Moore & Co. ..... New York City, N.Y.

National Engineering Products, Inc. ..... Washington, D.C.
National Lead Co. ..... Philadelphia, Pa.

Octagon Process Inc. ..... Edgewater, N.J.
Olympic Paint & Varnish ..... Los Angeles, Calif.

The Parr Paint & Color Co. ..... Cleveland, Ohio
Pennsbury Paint Co. ..... New Britain, Pa.
Pervo Paint Co. ..... Los Angeles, Calif.
Pittsburgh Plate Glass Co. ..... Newark, N.J.
Production Paints & Coatings ..... Brooklyn, N.Y.
Pur-All Paint Products Co. ..... Bronx, N.Y.

Radiant Color Co. ..... Oakland, Calif.
The Reardon Company ..... St. Louis, Mo.
Reliance Chemical Co. ..... Richmond, Calif.

Schnectady Varnish Co., Inc. ..... Schnectady, N.Y.
George Senn, Inc. ..... Philadelphia, Pa.
Sentry Paint & Chemical Co. ..... Philadelphia, Pa.
Sheffield Bronze Paint Co. ..... Cleveland, Ohio
The Sherwin Williams Co. ..... Philadelphia, Pa.
William Armstrong Smith ..... East Point, Ga.
Speco, Inc. ..... Cleveland, Ohio
Spe-De-Way Products Co., Inc. ..... Portland, Ore.
Sprayon Products Inc. ..... Cleveland, Ohio
Standard Enamel & Paint Corp. ..... Indianapolis, Ind.
The Sterling Varnish Co. ..... Sewickly, Pa.
Superior Paint & Lacquer Works ..... Huntington Park, Calif.
Switzer Brothers ..... Cleveland, Ohio

Thomasson of Pa. ..... Pottstown, Pa.
A. H. Thompson Co. ..... Berkeley, Calif.
Titanine, Inc. ..... Union, N.J.
Turco Products, Inc. ..... Philadelphia, Pa.

United Cooperatives, Inc. ..... Alliance, Ohio
Universal Coatings Inc. ..... Newark, N.J.

Vita Var Corp. ..... Newark, N.J.

Westinghouse Electric Corp. ..... Manor, Pa.
Wyandotte Chemical Corp. ..... Wyandotte, Mich.

Yosemite Chemical Co. ..... San Francisco, Calif.

Zac-Lac Paint & Lacquer Co. ..... Atlanta, Ga.

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MEDICAL SUPPLIES FOR DEFENSE TOTAL 65 MILLION

Military Medical Supply Agency Acts As Single Manager to Procure Armed Forces Requirements

THE MILITARY MEDICAL SUPPLY AGENCY, Department of the Navy, procured 65 million dollars worth of medical supplies for the Armed Forces in the past fiscal year.

Rear Admiral W. L. Knickerbocker, Executive Director, said that the Agency, with the Single Manager Assignment for Medical Materiel, used approximately one-half of the $65 million for drugs and biologicals. One-third of the total was accounted for in the purchase of three other general items: X-Ray equipment, medical and surgical instruments, and surgical dressings.

A small fractional balance of the total—about one-sixth—purchased other assorted types of materiel.

The Army was the largest customer of the Military Medical Supply Agency, followed by the Air Force, Navy and Marines in that order. The Military Assistance Program also came in for a share of the medical supplies.

Many Contracts

Procurement was accomplished under some 3,000 different contracts with chemical and pharmaceutical companies. Nearly one-third of these contracts ranged in dollar value from $2,501 to $10,000. Dollar-wise, the largest segment of contracting was in the $100,000 to $300,000 bracket where 91 contracts accounted for $15 million in purchases. Six contracts went over a million dollars each.

The eight companies who received the largest dollar volume of awards were:

General Aniline Film Corp.	(Large)	$5,382,039
Charles Pfizer Company	(Large)	$5,036,351
E. R. Squibb and Sons	(Large)	$2,552,219
Johnson and Johnson	(Large)	$2,085,949
Wyeth Labs	(Large)	$2,036,497
Lily-White Sales Company	(Small)	$1,663,695
Smith Kline & French Labs.	(Large)	$1,544,026
Parke Davis Company	(Large)	$1,509,175

These awards totalled over $21 million, or one-third of the dollar value for the fiscal year.

Big and Little Business

Comparing the whole expenditure, two-thirds of the awards were made to small business, while large business contracted for two-thirds of the dollars. It is another way of saying, as in other industries, that dollar volume isn't the small companies' dish of tea.

The ten standard items with the largest dollar volume of procurement were:

Oxytetracycline Tabs	$3,742,617
Film, Radiographic 14 x 17 in.	$3,700,057
Albumin Normal Human Serum	$2,022,936
Tetracycline Tabs	$1,503,020
Poliomyelitis Vaccine 9 cc	$1,430,211
Tetracycline Syrup, Buffered	$1,322,104
Pad, Gauze	$1,015,190
Film, Radiographic 10 x 12 in.	$ 947,248

These awards totalled $17,521,229, or 26.8% of the total awards placed during July 1949 to 30 June 1960.

Nation-wide Program

Contracts for the program were spread geographically across the country into nearly every state in the union. Most of the chemicals, drugs and medical supplies were, as a consequence, bought in the domestic or U.S. market. The exception being foreign purchases of less than a million dollars for medical, surgical, and dental instruments and equipment.

The MMSA also purchased $1,744,922 worth of foreign made drugs and biologicals.

Size of Awards	Number	Percent	Dollar Value	Percent
$1,000 or less	503	16.3	$ 258,257	*
$1,001 to $2,500	529	17.2	916,473	1.4
$2,501 to $10,000	1,057	34.3	5,681,179	8.7
$10,001 to $25,000	528	17.1	8,324,191	12.7
$25,001 to $50,000	217	7.0	7,515,974	11.5
$50,001 to $100,000	133	4.3	9,311,048	14.2
$100,001 to $300,000	91	3.0	15,006,515	22.9
$300,001 to $1,000,000	18	0.6	9,086,223	13.9
Over $1,000,000	6	*	9,296,249	14.2
TOTALS	3,082		$65,396,109	

*Less than 0.5%

MMSA PROCUREMENT SUMMARY FOR FISCAL 1960

Type of Item	Negotiated	Advertised	Total
Drugs, Biologicals, etc.	$32,514,148	$1,157,394	$33,671,542
Surgical Dressings	5,041,184	1,320,443	6,361,627
Medical and Surgical Instruments	7,105,463	913,790	8,019,253
Dental Instruments and Equipment	1,170,982	192,347	1,363,329
X-Ray Equipment, etc.	7,202,575	39,652	7,242,227
Hospital Furniture, Equipment and Utensils	2,636,281	381,782	3,018,063
Veterinary Instruments and Equipment	NONE	NONE	NONE
Optical Instruments and Equipment	1,675,634	NONE	1,675,634
Medical Sets, Kits and Outfits	186,996	6,875	193,871
Laboratory Instruments and Equipment	1,228,765	147,108	1,375,873
Other FSC Groupings	1,539,652	935,038	2,474,690
TOTAL OF AWARDS	$60,301,680	$5,094,429	$65,396,109

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DEFENSE SUPPORT OF CHEMICAL RESEARCH

(Continued from page 24)

"Studies of the relationship between chemical structures and biological function (including radiation protection) of toxic and therapeutic compounds as well as the preparation of new compounds for these purposes should be the subject of a sizable defense effort."

External research supported by the Services is accomplished by two methods, namely a contract, or a grant of funds made possible under Public Law 85-934. The latter method is preferred for use with universities or other non-profit research organizations.

Besides the basic research being conducted outside of the military establishment with federal funds, the Office of Science is vitally interested in assisting the Military Departments to develop and maintain an in-house laboratory research capability. Examples of this type installation might well be represented by the Naval Research Laboratory (Washington), the Army Signal Research and Development Laboratory (Ft. Monmouth, New Jersey), and the Air Force Cambridge Research Laboratories (Bedford, Massachusetts).

Special mention was made of the unique capabilities of the Army Chemical Corps laboratories at Edgewood, Maryland, which have been designated as the primary source of toxicological research in the Department of Defense. (See July-August issue of AFCJ, p. 19). This is one example of an in-house laboratory research capability being utilized for the benefit of all three Military Departments.

PEOPLE

Colonel Joseph C. Boyer, Executive Officer, Office Chief Chemical Officer, will retire 30 September 1960 after more than 35 years service.

Colonel Melvin W. Reed assumes the duties of Executive Officer in the Office of the Chief Chemical Officer.

Brigadier General William E. R. Sullivan, President of the Chemical Corps Board at Army Chemical Center, pinned First Lieutenant bars on 2d Lt. Andrew Kource.

Colonel John M. Palmer has assumed command of the Pine Bluff Arsenal. He was formerly Deputy Commander of the Training Command at Fort McClellan.

Lieut. General Arthur G. Trudeau received the degree of Doctor of Laws from the University of Michigan for his "ceaseless work to advance scientific inquiry."

BOOKS

Some of the reasons for fatigue and limits of human capacity for work are explained by Dr. David Bruce Dill, of the Chemical Research and Development Laboratories, Army Chemical Center, Md., in a new book, *"The Science and Medicine of Exercise and Sports."*

Dr. Dill, since 1947 the civilian scientific director of the Army's medical research program on chemical defense, is one of forty-two leading researchers who have contributed material to this technical book.

It is described by the editor, Mr. Warren L. Johnson of the University of Maryland, as a "mosaic of the entire field of exercise and sports."

Dr. Dill had previously served on the faculty of Harvard University, and from 1938 to 1947 was a professor of industrial physiology. During this time he played a major role in establishing and directing Harvard's unique Fatigue Laboratory. He is currently a visiting lecturer in physiology at the Harvard School of Public Health.

Dr. Dill has been a resident of the Wilna area of Harford County, Maryland, since 1953.

In any scientific field which is rapidly expanding, such as *"Frozen Free Radicals,"* there is need for a basic text for the newcomer. Applications of free radicals have been considered in combustion, astronomy and rocket propellants. Until a definitive text is produced, it is helpful to have G. J. Minkoff's monograph on this subject. He is to be congratulated for assembling this material and in particular his presentation of the chemical aspects of trapped radicals. These are the comments of Prof. H. P. Broida, National Bureau of Standards. Dr. Minkoff was formerly a professor of chemistry at the Imperial College, London. Interscience Publishers of New York and London have put the work between covers.

Development of the European Common Market, which can occur in many ways, is discussed in a report, *"American Industry in Europe,"* prepared by Arthur D. Little, Inc., Cambridge, Mass. The report deals with the chemical industry. It is 100 pages and available for $3.00.

REPORT ON RECENT RESEARCH BY U.S. AIR FORCE R&D

Air Breathing Engine Applied Research

THE OBJECTIVES of the appplied research are a major increase in the thrust to weight ratio attainable in turbojet dual cycle engine, higher mach number operating limits for ramjet, and self acceleration of ramjets. Both General Electric and Pratt & Whitney have contracts to experimentally investigate design techniques for increasing the performances and decreasing weight of gas turbine components, in a program called, "The Lightweight Gas Generator." Marquardt has contracts for experimental investigation of ramjet design to meet the above ramjet objectives.

Rocket Propulsion

During this period, the transfer of Air Force Rocket Propulsion R&D responsibilities from Wright Patterson AFB to Edwards AFB was completed. The move is expected to provide for closer liaison with contractors who are engaged in Air Force development work and with the Air Force Ballistic Missile Division which is responsible for the management of the Air Force Ballistic Missile Program.

Liquid Rocket Technology

Much emphasis has been placed on storable liquid propellants as a potential alternate approach to the solid rocket for first stage rocket booster and ICBM application. The storable liquid propellant is also being examined for use in space propulsion.

Solid Propellant Rocket Applied Research

In June 1960, the Air Force initiated a development program to explore the feasibility of segmented solid propellant motors for use in military rockets of a size too large to permit transportation as a completely assembled engine. A further advantage of the segmented solid propellant booster is the flexibility in thrust and total impulse attainable at minimum development cost and time.

Electrical Propulsion Applied Research

In response to an ARPA order, the development of a small ion rocket engine was placed on contract by the Air Force. The DOD transferred management of this project from ARPA to the Air Force in January 1960.

A test stand suitable for simulating approximately 100 miles altitude was completed at WADD. An experimental dual plasmatron ion engine was demonstrated in the test stand for DOD representatives during December 1959.

R&D contracts were awarded for continued study of a pulsed plasma engine, for design and test of an arc jet, and for development of equations to use with calculators for rapid study of engine parameters versus performance in missions requiring space propulsion. Models of both design concepts of electric wind propulsion device were tested at high altitudes. Tests were inconclusive, but pointed the way for further investigation of this possible means of propulsion.

Augmentation of RD in Propulsion

As a result of a conference 26 January 1960 with Dr. Charyk, SAFUS, additional funds were requested for selected propulsion projects. Funds were obtained for the following tasks:

Lightweight air breathing gas generator
Improved liquid rocket components
New propulsion technology

Development in Support of Weapons Systems

The Air Force continued the development of the following propulsion systems:

J52 engine for the Hounddog missile.
J57 engine for the KC-135 aircraft.
J60 engine for the T-39 aircraft.
J69 engine for the improved Q-2 drone.
J75 engine for the F-105, F-106 aircraft.
J79 engine for the B-58 and F-104 aircraft.
J85 engine for the Quail missile, the T-38 aircraft and the Q-4 drone.
J93 engine for the B-70 aircraft.
T53 engine for Army aircraft.
T55 engine for Army aircraft.
T56 engine for C-150 aircraft.
RJ43 ramjet for the BOMARC missile.
Liquid Rocket Engines for Atlas and Titan.
Solid Rocket engines for Minuteman.
Liquid Rocket engine for Centaur.

Other Engine Development

The T63 engine is processing on an Air Force contract using U.S. Army funds. The engine is designed to most future Army aircraft and helicopter requirements. Until December 1959, the T61 engine development was continued by the USAF. On 31 December the development was terminated because progress of turbofan engines had reduced the likelihood that the engine would be used for potential applications such as a logistic transport.

Air Force High Energy Boron Fuel Program

In July 1959 the Air Force cancelled the high energy fueled version of the B-70 aircraft. As a result the J93-GE-5 engine was cancelled and the 5 ten-day plant at Lewiston, New York, operated by Olin Mathieson, was closed.

A contract has been let to Callery Chemical Company to supply 300,000 lbs. of pentaterone to the Air Force. Since a plant modification is required to accomplish this, the Olin Mathieson .8 ten-day plant is being kept in a stand-by status until the Callery plant starts to deliver the material. The Air Force has not terminated its boron fuel research and development program. Some boron containing materials (pentaborane and decaborane) which have been derived from this program have good potential in the rocket propellants. The development program to evaluate these materials is being accelerated and the results to date appear promising.

Air Force Advanced Lubricants Program

A large portion of the applied research effort in lubricants has been re-directed to solve the lubricating problems which are anticipated for future aerospace rocket and flight vehicle power applications. Satisfactory lubricants and lubrication techniques are being developed to meet the severe conditions of temperature, radiation, low pressures, reliability, loads and speeds.

This program has developed a solid film lubricant for use at 1,000°F in sliding applications. In addition, two greases were developed capable of lubricating high speed ball and roller bearings for extended periods of time over the temperature range of −40°F to +400°F.

Jet Fuel Icing and Contamination

As a result of the emergency program to eliminate engine malfunction due to the presence of ice in JP-4 fuel, fuel heaters have been installed in B-52 and KC-

135 aircraft. In addition, a program is being conducted to investigate the possible use of additives in jet fuel to prevent the formation of ice in fuel systems. A B-52 flight test program has been initiated to test a group of additives selected after intensive laboratory and test rig screening.

Aerospace Environment Research

Studies were initiated during Fiscal Year 1960 to determine if the phenomenon of explosive warming of the Arctic's atmosphere is the source of water vapor, carbon dioxide, carbon monoxide and ozone above the Arctic's tropopause. The occurrence of these atmospheric constituents is of great importance in the use of infrared techniques in the stratosphere since they determine the infrared horizon.

Research on seeding the ionosphere with chemical stimulants for increasing electron density continued during Fiscal Year 1960 with more than 15 rocket firings, each of which was successful. Persistent electron clouds were formed lasting up to two hours. The seeding of the ionosphere is expected to permit selective absorption, refraction and scattering of communications signals.

During the past year joint Advanced Research Projects Agency (ARPA) and Air Force measurements were made on all USSR nose cone reentries in the Pacific. Significant results of reentry radiation were obtained.

World-wide fallout diffusion studies of radioactive and fusion product materials in the atmosphere were continued as an investigation by the USAF initiated by the Atomic Energy Commission.

Airborne gravimetric studies of the earth continued, using the Air Force developed airborne gravimeter, for determination of gravity data in previously inaccessible regions. These data are of great importance for the location or earth gravity anomalies having possible effects on inertial guidance systems, and for the establishment of the geoid.

Materials

Recognizing the importance of materials for future aerospace vehicles, the Air Force recently established an Air Force Materials Central at Wright Air Development Division, formed around the Materials Laboratory as a nucleus. The function of the Air Materials Central is to do that applied research needed by the Air Force that is not being done elsewhere; to have on record materials work that has been done and is being done that is of Air Force interest; to attempt to use materials in new ways for specific applications; and to maintain a "memory" capability of all materials R&D.

For the first time the Air Force has a central place where those interested in materials can go and hopefully obtain answers to any and all questions pertaining to materials.

Solar Furnace

As the result of a careful survey and deliberation the Air Force has determined that there is no longer a need for a solar furnace within the Department of Defense. A National Aeronautics and Space Administration Air Force committee has been formed to recommend what kind of facility should be established at Cloudcroft, New Mexico, in lieu of the solar furnace. Consideration is being given to the use of the Cloudcroft site as a possible location for a combination solar system-electro optical observation activity.

High Intensity Magnet Research Laboratory

Action has been completed on the Air Force support of a high intensity magnet research laboratory at the Massachusetts Institute of Technology. Air Force funds

(Continued on page 36)

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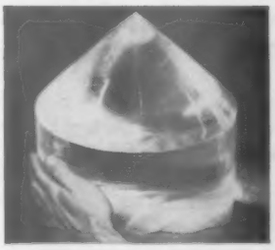

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WITH THE CHEMICAL CORPS

SEVENTH ANNUAL CHEMICAL INSTRUCTORS CONFERENCE

FORT McCLELLAN, ALA.—Military instructors, representing 13 Army activities, the Air Force, and Marines, attended the Chemical Instructor Conference at Fort McClellan, to discuss increased CBR integration into military training programs. The conferees representing more than 30 major service agencies met at the Army Chemical Corps' School to study new chemical developments and discuss problems of chemical instruction in their schools.

Brig. Gen. William E. R. Sullivan, President of the Chemical Corps Board, briefed the visiting instructors on chemical and biological agents.

Col. William H. Greene, Commandant of the Chemical Corps School, told the 50 conferees about the newest in chemical, biological, and radiological (CBR) doctrine and techniques together with the Corps trends and developments for the future.

Conferees touring the laboratories of the Chemical Corps School were given instructions on the use of newly Developed equipment which were supported by demonstrations of techniques used in chemical training.

Two conferees pause in the training aids display room of the Army's Chemical Corps School, Fort McClellan, Ala. Capt. J. J. Ball, Jr., left, and M/Sgt. (E-8) W. J. Fanning were among the instructors who attended the Seventh Annual Chemical Instructors Conference.

CHEMICAL ARSENAL HOST TO BOY SCOUTS

Rocky Mountain Arsenal provided a campsite for the Denver Area Boy Scout Council Camporee to accommodate ten Scout districts with a membership of 4,000 scouts and their leaders. By the time the Camporee got under way, 12,000 persons, including Scouts, Scout leaders, parents and visitors had attended.

The campsite was put in shape by volunteer labor. Equipment was furnished by Lowry Air Base, Fitzsimmons General Hospital and the Colorado National Guard. The 156th General Hospital Unit came out of reserve and to active duty to provide medical care and facilities for the Scouts.

Boy Scout Camporee, at Rocky Mountain Arsenal, Denver, Colorado. Left to Right (Standing): Scout Al Buenger; Major R. Y. Batterton, of Denver; Col. William J. Allen, Jr., Commanding Officer of Rocky Mountain Arsenal; Mr. John M. Schooley, Manager of Safety, Director of Public Works, City of Denver; Mr. Harold F. Silver, Pres., Denver Area Scout Council. (Kneeling): Mr. George A. Mozealous, Boy Scout Executive, Denver Area Scout Council.

COL. CASTRO COMMANDS DETRICK LABORATORIES

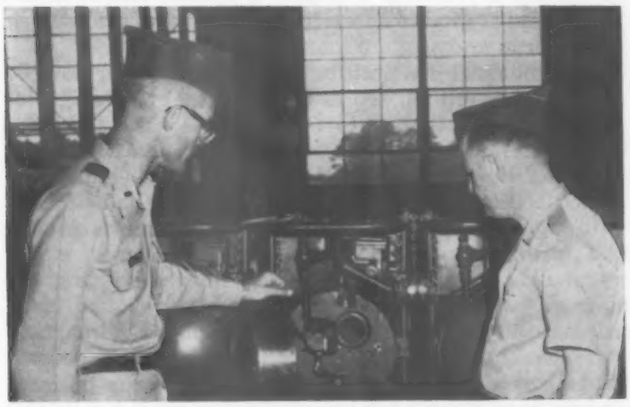
Colonel Carl S. Castro, CmlC, has assumed command of the U.S. Army Biological Laboratories, Fort Detrick, Frederick, Maryland.

He had been serving on the Joint Chiefs of Staff, the Pentagon, as a member of the Weapons Systems Branch, J-4.

Colonel Castro, who succeeds Colonel L. A. Parks, CmlC, now attending the Army War College, is married to the former Miss Georgia Frances Annette, of Columbus, Ohio. They have a son, Donn, 17, a senior at Frederick High School, and a daughter, Carol, in Junior High.

Colonel Castro served with the 11th Airborne "The Angels," in the Pacific Theater, and was awarded the Legion of Merit. He holds a B.S. in Chemical Engineering from Ohio State, class of '38, and a M.B.A. from the Harvard Business School, class of '49.

GENERAL ESSMAN VISITS TRAINING COMMAND



Brig. Gen. Graydon C. Essman, commanding the U.S. Army Chemical Corps Materiel Command and Army Chemical Center, inspects mechanical smoke generators of the 218th Chemical Battalion (Smoke Generator), 100th Chemical Group, at Army Chemical Corps Training Command, Fort McClellan, Ala. At left is Lt. Hazard E. Reeves, Jr., of the 62d Chemical Company (Smoke Generator), 218th Battalion.

From left to right, Cadets Robert Mitchell, Missouri School of Mines, Norman Petty, Georgia Tech, Edward Tucker, MIT, Ronald Falk, Purdue, and Warren Wagner, Michigan Colleges of Mines and Technology, are shown after completing two weeks summer training at Fort Gordon ROTC Summer Camp. They are departing for Ft. McClellan where they will attend the CBR School.

CHEMICAL CORPS AWARDS

Research and Development Command

Length of Service Certificates to—*Miss Evelyn V. Becker* and *Mr. Robert A. Bergseth*, 20 Years Service; *Mrs. Rassell W. Thompson, Mr. Irving Cort, Mr. Pat Brewer, Mrs. Gladys P. Silber,* and *Mr. William P. Hodgkinson,* 15 Years Service; *Mr. Roger J. Lerwill,* Safety Director, 5 Years Service.

Sustained Superior Performance—*Mrs. Carmen E. Turner* and *Mrs. Rassell W. Thompson.*

Certificate of Achievement—*Mr. Pat. Brewer.*

U.S. Army Cml Procurement Dist., N.Y.

Outstanding Performance—*Mr. John S. Szala.*

Suggestion Award—*Mr. Vincent Buglione* and *Mr. Frank Rosso.*

Rocky Mountain Arsenal

Sustained Superior Performance (with $150 Cash Award)—*Mrs. Bette M. Trout* and *Mr. Nathan Spencer.*

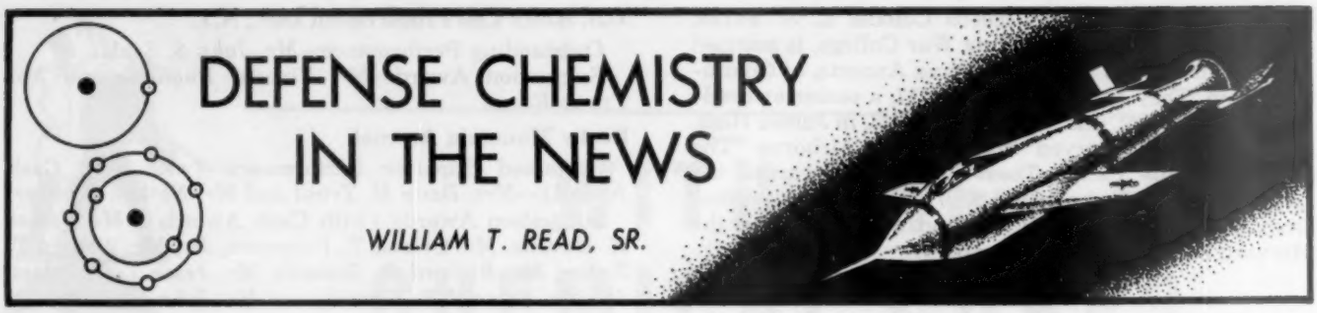
Suggestion Awards (with Cash Awards): *Mr. James H. Havens, Mr. Orland T. Patterson, Jr., Mr. Warren T. Zuber, Mr. Richard D. Samuels, Mr. Jesse T. Douglass, Jr., Mr. Edward R. Kascak,* and *Mr. John W. Utecht.*

Colonel William J. Allen, Jr., Commanding Officer, Rocky Mountain Arsenal, was host to His Royal Highness, Prince Mohammed bin Talal, Heir Apparent to the Throne of the Hashamite Kingdom of Jordan, who recently visited the Arsenal.

Colonel Allen also escorted the Prince by automobile to visit the Air Force Academy, Colorado Springs. (Left to Right): Prince Mohammed of Jordan; Brigadier Mujalli of the Army of Jordan; and Colonel William J. Allen, Jr.

UNDER SECRETARY OF THE ARMY VISITS ARMY CHEMICAL CENTER

Under Secretary of the Army Mr. Hugh M. Milton II, is greeted at Weide Field by Brig. General Graydon C. Essman, Commanding General of Chemical Corps Materiel Command and Army Chemical Center.



DEFENSE CHEMISTRY IN THE NEWS

WILLIAM T. READ, SR.

This Department consists of condensations of news releases and of articles in technical journals relating to developments in chemistry, chemical engineering, and kindred subjects, which are of definite or probable military interest. For the benefit of readers who may wish to refer to the source material upon which the paraphrased items are based, the source publications used for this review with appropriate reference numbers are listed after the last item of the text herein.

METALS

As a part of an investigation conducted for the Air Force on stress-dependent relationships in which ultrasonics constituted the method chosen, it was found that residual stresses in metals can cause double refraction of a polarized shear wave. This has led to a technique of measuring the average stresses through certain materials based on the double refraction of shear waves. The interaction of two ultrasonic waves in metals made up a portion of this research.[1]

Low grade iron ores (under 50%), and particularly those containing chromium and titanium, are now being processed in two large plants with two others planned or under construction. The blast furnace of the ordinary steel plant is replaced by a rotating kiln feeding into an electric furnace, and coal is employed instead of coke, the coal often being of a low grade. One plant in New York (Niagara Falls) will convert chromitic and lateritic ores, at present unusable, into stainless steel. Another in Venezuela has a capacity of 1.2 million tons per year, and will use low-grade coal from their own country rather than imported coke. Low-grade Texas ores will be used in two plants in that state. A deposit of an estimated 2 billion tons of an ore containing 45% iron and 12% titanium dioxide in Quebec is to be worked by this process, a material hitherto not worth shipping because of the difficulty of removing titanium dioxide by present processes. Ore is fed into several points along the kiln. More than half of the ores are reduced to metallic fines, which flow readily into the electric furnace. In this the electrodes are submerged in molten slag so that the solid charge is kept away from them. The slag covers a layer of molten metal, while gases escape from it and burn in the kiln. The secret of the process is said to lie in the composition of the slag, which serves as a solvent for metallic oxides, there being selectivity of reduction depending on the free-energy differences of the various reactions. Composition of the slag is carefully controlled, and metals are reduced one after the other.[2]

Another process which bypasses the blast furnace utilizes fine ore particles that are formed into pellets with hot plastic coal, which is of the high-volatile type. Tumbling and heating serve to solidify the mixture so that hard, porous pellets are formed. Fine limestone or dolomite may be incorporated into the pellets, or the fluxing material may be fed along with the pellets as they enter a rotating retort. The heat in the retort results from the burning of the carbon monoxide produced as the ore is reduced. The pellets become friable in the retort, and are fed to an electric arc furnace, from which molten iron and slag are intermittently tapped.[3]

The chemical composition of sheet steel can now be altered after rolling. Up to this time the percentages of alloying elements had to be adjusted while the steel was in the molten state, a very tedious operation. Often the specially compounded steel was very hard and presented rolling problems. The new method can be used with any element that can be gotten into the form of a gas during the annealing operation. A layer of either nylon or corrugated steel strip is inserted during the rolling operation, and this is later withdrawn to leave a loose coil of sheet steel. This coil is lifted by magnets into the annealing furnace and hot gases are blown through it as annealing progresses. Heating is uniform and the time required is lessened in comparison with the older processes. Carbon, nitrogen, or any other element that is present in the gas stream may be added or removed as desired. Stainless steels can thus be made with lower carbon content than those presently available. Carbon can be removed with moist hydrogen, and both carbon and nitrogen can be taken out to a point where normal methods of detection will not reveal their presence. Older methods of adjustment were limited to 0.06% carbon and 0.003% nitrogen.[4]

Uranium is said to offer promise in the making of tool steels, its stable carbides aiding in hardening such steels. Sold uranium—iron solutions are of assistance in the tempering process of steel. This element also forms stable oxides and nitrides, making it useful in steel metallurgy generally. Depleted uranium from U-238 extraction is competitive with tungsten and molybdenum alloying compounds.[5]

Substitution of burned lime for limestone as a flux in the open-hearths using oxygen-natural gas combination lances can increase production rates of steel fully three fold. The temperature of the combination lances already is higher than those of the usual end-fired fuel burners with auxiliary oxygen lances. The use of burned lime avoids the loss of heat required to convert the carbonate to the oxide, so that molten iron can be introduced earlier with less danger of freezing the furnace charge.[6]

A study of materials for high temperature fabrics for use in re-entry parachutes, made by the Air Force, has indicated that the best materials so far investigated are nickel-chromium and cobalt-chromium alloys in the form of fine wires. These wires, even without coatings, have sufficient oxidation resistance for the environmental conditions of re-entry. Work is continuing on materials which may be melted and spun into filaments, these including vitreous silica and aluminum silicate fibers. The technique and theory of spinning and cooling are being studied. Some of the materials tested may prove suitable for uses other than parachute fibers, particularly those which require extreme strength and operational capability up to 1500°F.[7]

In an effort by the Air Force to find better ways of preparing refractory metals of ultra high purity in large forms which conform to spectrochemical standards, a method of halide reduction of high-purity starting rods for zone melting has been developed. Volatile halides were purified by fractional distillation and ion exchange reactions. Elements covered in this research include tungsten, molybdenum, tantalum, niobium (columbium), and zirconium.[8]

Out of 39 intermetallic compounds tested by the Air Force for high temperature applications, 19 showed sufficient oxidation resistance to be suitable for structural service in air temperatures up to 2300°F. All of the compounds tested had melting points above 2550°F. The intermetallic compounds subjected to high temperatures in the presence of air included aluminides, beryllides, silicides, germanicides, and zirconides.[9]

Titanium may now be used in reducing as well as oxidizing atmospheres by being alloyed with 0.2% palladium. Unalloyed titanium suffered excessive corrosion in boiling sulfuric acid dilute solutions and concentrated calcium chloride solution, while the alloy suffered no corrosion after weeks of testing.[10]

Helium is being used as a cooling medium instead of water in arc-melting of recovered titanium scrap, thus avoiding danger of explosive reactions of molten titanium with water in the event of jacket failure. The initial charge is melted under an argon atmosphere, four thoriated tungsten electrodes being employed. Additional scrap is added through a charging unit, and the metal is arc-melted under vacuum to remove hydrogen and other gases that do not form stable titanium compounds. Solid metal in the crucible tip is melted by a fifth permanent tungsten electrode before the metal is poured.[11]

Niobium (still often referred to as columbium) may be made economically by reduction of its pentachloride by hydrogen in a fluidized bed. Hydrogen and sublimed niobium pentachloride are passed through a bed of small particles of niobium in a vertical reactor operating at 1475°F. Niobium plates out on the seed particles. These are separated from hydrogen when they have reached sufficient size, and some of them are reground to replenish the seed supply. Niobium is strong at high temperatures, can be alloyed to produce materials that will resist oxidation, has relatively low density, and its thermal neutron cross section is also relatively low. Production of niobium in 1958 was only 33 tons, but ferroniobium and ferrotitanium-niobium, used in alloying steels, was 430 tons.[12,13]

The volume of freight airlifted has led to the development of lightweight aluminum crates by the Air Force. These are space-saving, can be re-used, and withstand rough handling. They are made of formed aluminum channels, and the crates may be adapted to other structures in addition to the original use of shipping airframe components. Weight reduction is accompanied by meeting all strength requirements of such crates. In connection with shipping aircraft parts, a pressure-sensitive tape has been developed by the Forest Products Laboratory of the U. S. Department of Agriculture for the Air Force, these tapes being employed in suspending the items in their containers. The tapes are glass-filament-reinforced, black polyethylene, which have successfully withstood exposure to ultraviolet light, alternate wetting and drying, and even increased in tensile strength and toughness after freezing at zero temperatures.[14]

Coal mines may become another major source of aluminum if a 40,000 ton per year aluminum sulfate plant, shortly to be built, is a financial success. One large coal company, which is undertaking this venture, produces millions of tons of shale along with their coal, and this contains from 20% to 25% alumina. This shale is treated with sulfuric acid, and aluminum sulfate is recovered after silica and other impurities are filtered from the solution. The recrystallized sulfate has less than 0.005% iron. Aluminum sulfate can be decomposed by heat to yield alumina, and the sulfur trioxide can be returned to the original sulfuric acid process. Since the alumina so produced has a very low soda content, it is suitable for production of aluminum by the usual electrolytic process.[15]

NUCLEAR CHEMISTRY

A new process for producing deuterium is being developed in England, particularly for use heavy-water-moderated reactors in countries that have access only to natural uranium nuclear fuel. The process starts with ammonia synthesis gas, which is cooled to −40°C and passed to a packed tower at 250 atmospheres. A liquid ammonia stream containing potassium amide catalyst strips about 70% of the deuterium from the synthesis gas, which is a mixture of hydrogen and carbon monoxide. The liquid ammonia goes to a second column to meet a deuterium-enriched ammonia gas. The liquid ammonia from the column bottom now has 25 times as much D_2 as the original hydrogen. Half of the liquid is handled in a seven-column distillation train in which deuterium is concentrated to a 75% material. By exchanging deuterium in this product with demineralized water permits concentration of water to 99.8% deuterium oxide, D_2o. The other half of rich ammonia liquid meets lean ammonia gas in a high pressure (250 atm.) column operating at 100°C. Enriched gas is recycled to a second column.[16]

Zirconium hydride is being investigated as a substitute for water in the superheater section of boiling-water nuclear reactors, since this hydride requires no thermal neutron shielding. Thus the reactor employing zirconium hydride as a moderator could be operated with only slightly enriched uranium. Fuel cost reductions are expected to offset the high costs of the hydride.[17]

Small nuclear reactors may advantageously employ niobium-uranium alloys to avoid the swelling of metallic fuels, this effect rendering them unserviceable above 1200°F. A niobium alloy carrying 20% uranium is said to retain adequate tensile strength and hardness at 1600°F. Compact reactors in power generators and ship propulsion and gas-cooled reactors operate at higher temperatures than the other types.[18]

The low thermal conductivity of uranium dioxide, which is its main drawback as a nuclear fuel, has resulted in the addition of fine fibers of molybdenum, the conductivity being increased from 30% to 60%. The amount of molybdenum incorporated in uranium dioxide is of the order of 10% to 20%. Claddings are made of zirconium or aluminum. Other materials being investigated include uranium carbide, thorium dioxide, thorium dioxide-bismuth, and cermets and metal alloys.[19]

Foam separation techniques promise to increase the efficiency of atomic wastes disposal by reduction of both cost and bulk. Solutions containing ions of radioactive elements are exposed to the action of gases which bubble through them in the presence of a surface-active complexing agent. The foam which contains these is produced and continuously collected from the surface. The process has been used for removing strontium 90 and cesium 137 from wastes derived from reprocessing reactor fuel elements. It appears likely that this method

may also be applied to compact waste-disposal systems on nuclear-powered ships.[20]

By-product hydrogen chloride, often a waste material where there are no requirements for it either in the same plant or in closely neighboring plants, is now being profitably converted into chlorine and hydrogen. This is accomplished by electrolyzing 33% hydrochloric acid in equipment resembling in appearance a plate and frame filter press. Frames are made of fiber-reinforced phenol-formaldehyde resin. Both electrodes are made of graphite, the cathode a plate and the anode a collection of lumps, the two being separated by a polyvinyl chloride diaphragm. Some forty frames make up the electrolyzer. By-product hydrogen chloride of practically any grade, even that containing as much as 10% hydrocarbons, may be employed, being absorbed in depleted hydrochloric acid from the electrolysis operation until a sufficiently concentrated acid is obtained. Pure hydrogen and 99.9% chlorine are the products, while spent acid of 18% concentration is recirculated or wasted. The chlorine is dried with sulfuric acid and returned to the original chlorination process from which the hydrogen chloride was derived.[21]

Zinc as a fuel for the conversion of chemical to electrical energy is said to offer the advantage of operating at close to ambient temperatures and pressures, being self-charging to eliminate waste products, adapted to mass production in a variety of shapes, having high electrical conductivity, and uniform reactivity over the current-producing surfaces. Low-pressure oxygen is the oxidizer, and potassium hydroxide is the electrolyte. The zinc fuel is in the form of a fine powder, which is combined with a catalyst and pressed into thin-walled tubes. These tubes are supported by perforated polyvinyl chloride plastic and woven glass fibers made into tubular forms and arranged around a central positive electrode. The oxide formed in cell operation may be reconverted to metal powder by reversal of current.[22,23]

Navy research on the conversion of thermal energy into electrical energy has resulted in the development of a lithium hydride cell that will operate regeneratively and a potassium hydride cell that operates with a peak open circuit voltage of 0.33 volts. This research has included single electrode potentials, alternate hydrides and solvents, redesign of closed cycle systems, and differential thermal analysis.[24]

INORGANIC CHEMISTRY

Users of very pure hydrogen (99.995%), and formerly dependent on cylinder supplies, may now get hydrogen of this purity from ammonia. For many years ammonia has been catalytically cracked to nitrogen and hydrogen for processes in which a 75% hydrogen along with 25% (volume basis) was satisfactory. The cracked product is now being dissociated, compressed, freed of any residual ammonia, and cooled to −275°F in counter-current equipment. It is further chilled by liquid nitrogen, which boils at 50 mm. (Mercury absolute) at −345°F, followed by a separation system which yields very pure hydrogen. Operations are carried on at 600 psi. The liquid nitrogen from which most of the hydrogen has been separated is passed into another separator under lower pressures so that dissolved hydrogen flashes off.[25]

The Army has developed a portable hydrogen generator in which diesel fuel is substituted for methanol. Mounted on a semitrailer, the unit can produce 1000 cubic feet of hydrogen an hour. Steam reforming is followed by a water-gas-shift reaction, and carbon dioxide is absorbed in ethanolamine, with final production of 98% hydrogen on a volume basis. Major impurities are carbon monoxide and methane.[26]

An investigation in the field of boron hydrides, conducted for the Air Force by a contractor, includes a method for preparing diborane by radical-catalyzed reaction of trichloroborane and monosilane. Diborane has been converted by steps to pentaborane-11. Properties determined for tetraborane-8-carbonyl included vapor pressure, infrared spectrum, NMR spectrum, and mass spectrum. A new amine derivative of a borane is also reported.[27]

The large quantities of carbon dioxide which are being removed from natural gas in the newer fields may have a profitable outlet in a process of recovering petroleum from formations that have been formerly treated with water alone. Water saturated with carbon dioxide is said to force oil to the surface faster than the rate attained by the older process. A large carbon dioxide liquefaction plant is now being built with a daily capacity of 140 tons, and will get its raw material from neighboring carbon dioxide removal plants operating with natural gas and using the new process recently reported.[28]

Oil well drillers may now be supplied with what is called "weighted water" to supplement or replace drilling mud, which is a suspension of solids. This material is a concentrated solution of calcium chloride. Pellets of the solid chemical are shipped by tank car, and dissolved in water, the maximum density with calcium chloride being 11.7 pounds per gallon. The stock solution is usually somewhat less dense than this figure, and may be reduced by dilution as required in the operation. A density of 14 pounds per gallon may be obtained by addition of zinc chloride.[29]

In order to avoid the necessity of shipping and returning cylinders emptied of nitrous oxide, a field supply of anesthetic for use under combat conditions, the Army's Corps of Engineers has acquired a mobile generating plant, that is mounted on skids that will fit into a flying boxcar. The two units are connected by a nylon-plastic surge bag that has 300 cu. ft. capacity, but which weighs 30 pounds and falls into small space. The plant is constructed to lightweight metals, largely aluminum and glass-fiber-reinforced polyester resin. Ammonium nitrate, which can be shipped in bags, is used as the source of nitrous oxide. It is melted and run into decomposition pots, the product is scrubbed with caustic soda, sulfuric acid, and steel wool, and from the surge bag to compressors, further hot caustic scrubbers, dryers, and finally to a refrigeration unit, where it is liquefied at 1000 psig., with fractionation to remove nitrogen.[30]

A proposal to utilize the energy of free radicals is based on the absorption of diatomic gases such as hydrogen in palladium, after which the palladium is subjected to radiations including solar, radio, microwave, alpha particles, beta and gamma rays. The stream of free radicals is directed on a selective catalytic surface, where the recombination produces heat or may result in a stream of electrons. The diatomic molecules may be recycled. The discoverer of this process claims that an apparatus no larger than a silver half dollar can generate at least 200 watts of electrical power. Several working models have been made, and larger models are planned. Hydrogen yields 103 kilocalories per mole when recombined from its atoms. While fuels for rockets and space vehicles would appear to be the most immediate application, it could conceivably become a source of power for remote areas and undeveloped countries.[31]

Polycrystalline rods with diameters up to 22 mm. and lengths up to 450 mm. are being made by hydrogen reduction of trichlorosilane. They are subsequently zone refined to single crystals which have resistivities above 1000 ohm-cm. and minority carrier life-times greater

than 400 microseconds. Between the two operations they are rolled in cellophane, sealed in polyethylene envelopes, and shipped in corrugated cardboard placed in a tube.[32]

Carbon linings of aluminum cells are beginning to be replaced by nitride-bonded silicon carbide refractories. This material is insoluble in molten cryolite, has higher electrical resistivity, cuts power loss through the cell walls, which may be made thinner, and gives longer operating life. With titanium or zirconium boride cathodes, the entire cell will be lined with silicon carbide, rather than leaving carbon cell bottoms for cathode action.[33]

Thin films for potential use in composite molecular electronics have been investigated for the Air Force. Particular attention was paid to pyrolytic deposition of thin films with high temperature stability. A titanium-copper-nickel alloy was bonded on copper followed by depositing titanium dioxide by the pyrolytic decomposition of triethanolamine titanate. Other work covered the preparation and properties of silicon carbide films and metal oxides, and the preparation of insulating films on copper. The purity of test films was verified by spectral analysis and spectral transmission measurements. Thickness measurement was carried out by beta-ray backscattering.[34]

ORGANIC CHEMISTRY

An achievement in the field of basic organic chemistry research has just won world-wide recognition and praise, this being a total synthesis of chlorophyll from off-the-shelf chemicals. About the same time as the first announcement of this research accomplishment was made, a German team of chemists reported a chlorophyll synthesis which was the completion of the work begun by the late Dr. Hans Fischer, this being based on the breaking down of the natural product and reassembly of the various simpler compounds. Professor Robert B. Woodward of Harvard and nine of his co-workers (out of the 17 who assisted in this research at one time or another) announced the result of several years work in the "letter-to-the-editor section of the Journal of the American Chemical Society, the communication covering less than two printed pages. In all 28 steps were given, which did not include syntheses of intermediates made from still simpler compounds. Some of the sentences in this letter would have done credit to Lord Macaulay. Since it appeared necessary to tie a number of the steps closely together. this was done by such expressions as "thence" and "which was."

Professor Woodward has already to his credit such notable achievements as the synthesis of quinine, lysergic acid, cortisone, cholesterol, strychnine, and morphine. No immediate industrial or military applications are seen for this long and intricate synthesis of chlorophyll. but this work has probably more to do with national defense than many hundreds of researches that pay immediate dividends. Its significance lies in the revelation of the greatest of our national resources. which is the availability of devoted scholars of great ability who are capable of fundamental research of the highest order. This discovery may help to awaken this country to the value and the international prestige of work of the type done by Professor Woodward and his colleagues at Harvard.[35,36,37]

RUBBERS AND RESINS

Rubber that will meet the most exacting electrical requirements for absence of inorganic impurities is being produced by a combination extruder-dryer. Wet rubber crumb is fed between a conical casing and a conical dewatering screw, and passes through a long cylinder in which conveying is done by a screw with close clearance while being heated under low pressure. At the end the rubber is discharged through a die and rotating cutter in the form of dried pellets. Moisture is reduced from 50% to less than 0.5% in a matter of minutes, as contrasted with two hours in the usual three-pass hot air drying process. As a consequence of the squeezing operation, very little of the inorganic salts present in the water is left in the product.[38,39]

A carboxy-terminated polybutadiene binder gives promise of showing decided superiority over the present polybutadiene-acrylic acid copolymer in the manufacture of solid propellants. This is said to be due to the fact that in the older type of binder the active carboxy groups fall into the molecular chain in a random manner and chain length is hard to control. The new material has a symmetrical structure with parallel hydrocarbon chains and cross linking parallel to the chains. Elongation is also considerably greater and, although not fully evaluated because of such recent development, storage life appears to equal that of present propellants.[40]

Manganese steel, ceramics, and rubber are now reported as being greatly surpassed in abrasion resistance by polyurethanes made from hydroxy-terminated polyesters or polyethers and diisocyanates. Chute linings handling iron ore made from manganese steel gave away after the passage of 60,000 tons of the ore, while polyurethane elastomers showed no signs of wear after handling 950,000 tons of the ore. In a sugar-grinding machine, polyurethane scrapers had ten times the useful life of rubber scrapers.[41]

Casein and similar protein additives are being eliminated in a new all-synthetic interior latex paint in which the styrene-butadiene is thickened by methlylcellulose. No preservative is needed in this paint as is the case with proteins which are subject to bacterial deterioration. The paint not only has good properties, but requires less titanium dioxide. This development is of particular benefit to small paint manufacturers, since protein materials require special equipment.[42]

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EXCERPTS FROM THREE SPEECHES AT AFCA ANNUAL MEETING

Organization of the Military Space Effort

The Defense Department's role in space is to increase the effectiveness of weapons of defense, retaliation, information, and logistic pursuits.

The missile program disclosed to the Defense Department that none of the Services alone were interested in all potential uses of these missiles. For this reason, the space effort in the Department of Defense is carried on by the Service having a specific interest in a program objective.

The space program is up in dollars from $392 million in 1960 to $561 million in 1961. These funds are for five major projects:

1. Discoverer (Air Force)
2. Advent (Communications program of ARPA now being transferred to Army)
3. Transit (Navigation—managed by Navy)
4. Midas (Early Warning—Air Force) Samos (Recon Satellite—Air Force)
5. Booster Program (Air Force)

Ground installations have increased in the space effort to over 100.

We cannot become complacent, but must adjust the organization to meet the needs of the situation.

Air Force Ballistic Missile Program

Program

The USAF ballistic missile program is the largest military development ever undertaken by the U. S. in peacetime.

We have compressed time and expanded technology.

Our efforts are now devoted to completion of acceleration test programs, reliability, maintenance, manufacturing, inspection, safety and deployment.

History of chemical industry with its engineering, production, handling and marketing of dangerous materials leads us to feel proper and timely action can be taken in this program.

ICBMs

Highly accurate, will go underground into silo emplacements.

TITAN

Range more than 5,000 miles. Each of 9 missile silos required for one Titan squadron has an inside diameter of 4 ft. and is deep enough to house a 15-story building. 14 Titan squadrons are now under construction.

TITAN II

Storability of propellants helps provide *instant readiness* jam free, can be launched in salvo.

MINUTEMAN

Medium ICBM, describes its size only.

Solid propellant can be stored in instant readiness.

The ATLAS

Will lift the Mercury capsule for National Aeronautics and Space Administration, carrying the first American astronaut into orbit.

For those who wish—inquire about requirements in the Applied Research Planning Document Release Program of the Air Research & Development Command at Andrews Air Force Base, Maryland.

Saline Water Conversion

Studies indicate that plants of 25 to 50 million gallons per day can produce fresh water for less than 50 cents per gallon.

A plant is to be built on East Coast, using the freezing process developed by Struther-Wells and Scientific Design.

Within 20 years the U. S. will have 600 billion gallons of water per day, compared with 300 billion gallons daily now. And over 1,000 cities and communities were forced to curtail use of water in 1957, a year of moderate drought.

Members of the Armed Forces Chemical Association have a great role to play in this crucial effort.

AIR FORCE R&D

(Continued from page 29)

have been provided to construct this research laboratory. When completed the laboratory will be operated by M.I.T. by contract with the Air Force. This laboratory will be available to qualified scientists in the pursuit of basic research.

Basic Research

In Propulsion research, a workable laboratory plasma engine was demonstrated at AVCO. Short period specific impulses up to 1,000 sec were obtained. There has been increased activity in electric propulsion, both ion and colloid. Using results of basic research on ion propulsion applied research was started on a 1/100 pound demonstrable ion engine. An attempt was being made to obtain in the solid propellant formulation, specific impulses up to 280 sec.

In Materials research, color centers and crystal lattice deformations were being looked at. "Whiskers" showed fantastic tensile strength capabilities of the order of 3 x 10^6 psi. A new instrument, the Plasmatrom, capable of 10,000 degrees Absolute sustained temperature had been developed. Some research was successful in tracing one part in 10^9 impurity of Slicom. The first in-house "diamond" press has been built.

In Electronics, the MASIR was being exploited in radar astronomy as an extremely low noise amplifier. Research was initiated on Optical Pumping research to develop a coherent IR generator. Information Complexes were being emphasized especially in research on self-adapting and self-organizing control systems. The in-house Radar Astronomy Laboratory was one of two organizations to get any solar eclipse data. The first solar bounce was accomplished by Stanford. A continuous moon bounce communications system was initiated between Scituate, Massachusetts, and Jedrall Bank, England.

In Geophysics programs, environmental hazards research studies of space and near space were begun at balloon and U-2 altitudes for Project Mercury and Dyna Soar. Studies began in Arctic ray path anomalies for use in Vela (detection of nuclear bursts). Data gathering projects were given additional emphasis on the determination of stratospheric water vapor content useful in the employment of infrared above the tropopause. A series of rocket-borne magnetic field investigations were undertaken to gather magnetic field strength variations during auroral and solar prominences.

In the Biosciences research area, work was initiated to carry "tissue equivalent" ionization chambers and biopacks into high geomagnetic latitude regions to study the environmental hazards of space flights. Initial studies were begun in attempting to develop an artificial neuron model for possible extrapolation to more advanced computer technology. A number of studies were also initiated to ascertain the energy conversion processes in living systems for possible closed ecological system for space flight.

In the Aeromechanics research area, the technical basis was established for the Mach 15, 9000° Kelvin, "Big Rollo" gas dynamics facility at Cornell Aero Labs.

THE NEW COMMUNIST CLASS

IT IS RATHER paradoxical that the success of many political theories should be due to lack of knowledge concerning the basic points. Propaganda often has the evil effect of making people believe in things which are not true. Thanks to the constant repetition of slogans, the minds of men begin to falter and they accept as facts the subtle declarations specially made to deceive them. Naturally, there is always a difference between theory and practice. Theorists are usually honest and have faith in what they propound, but this does not mean that their ideas are realizable. It is up to us to see the results achieved by the followers of a theory, so as to judge whether the initial object has been respected.

With regard to the theory of Marxism, how far has it managed to establish an egalitarian society? A glance at life in the Soviet Union and in the Satellite States makes it quite clear that class distinctions are far from having been abolished. The communist principle of perfect equality among men has now become a myth, only suitable for export to sympathizers in the free world. The truth is that a new privileged class has sprung up in all countries under a communist régime. In order to belong to this class, it is necessary to be a faithful Party member. By creating a solid group of supporters, who are anxious to remain in the good books of the State leaders, the Soviet Government is making it all the more difficult for popular discontent to have any tangible effects.

During the early days of the Russian Revolution it was laid down that no skilled worker or member of the government might receive a wage higher than double that of an unskilled worker. However, this rule was progressively ignored, until in 1931 Stalin finally put an end to what he called 'equalitarianism'. Thus, the new social *élite* was given official permission to take full advantage of the situation. Despite the dangers of periodical purges, which have already brought about serious changes, there still remains a Soviet *élite;* the proof that wealth is very unequally distributed is that a so-called shock-worker may receive twenty times more than the lowest paid worker.

The bureaucratic upper class of the Soviet Union not only receives higher wages than the simple worker, but is also better treated by the social insurance legislation. This proves that communism prefers to help those who play an active part in maintaining the régime rather than those who are really in need. Only after working twenty-five years may one obtain a respectable old age pension. The widow of a worker receives a pension equal to the full average wage of the deceased breadwinner only if she has two dependent children. But the widow of a high-ranking government official, a member of the armed forces, a star actor and the like, receives a large lump sum, a pension for herself, and one for each child under age in proportion to her social position. The trade unions cannot do anything about this, since they are controlled by the State, and wages, working conditions, holidays and such matters are fixed by higher authority. The only task allotted to trade union leaders is to carry out the plans for higher productivity.

The social situation in Bulgaria after fifteen years of communist rule provides innumerable examples of how far Marxist practice has deviated from theory. It is estimated that the new *élite* there enjoy a standard of living at least ten times higher than that of the average Bulgarian. Here again, the advantages do not only consist in better wages, but also in many other facilities, such as bonus schemes, special food stores, cars, lodging accommodation, etc. In fact, most of the help and comfort provided by the State goes to Party functionaries; and since price reductions usually apply to luxury goods, they do not affect the ordinary worker, whose basic living expenses always remain high. There are two cases in which the rights of the privileged class appear particularly unfair. One is the special medical attention they receive in the two most modern hospitals of Sofia, exclusively run for the active supporters of the régime. The other is the system of selection for entry to high schools and universities in which the criterion rests upon political discrimination.

In such circumstances all that can be said is that, although communism has brought about fundamental social changes, it has failed to create a classless society of a real workers' state, facts which cannot fail to be noticed—however reluctantly—even by well-wishers abroad.

NOTE: *This article is reprinted from the NATO LETTER, a publication of the North Atlantic Treaty Organization.*

EXPRESSES THANKS

DR. WENDELL F. JACKSON

President Wendell F. Jackson, Armed Forces Chemical Association, expressed thanks to the Department of the Air Force "for their help in programming the agenda for the 15th Annual Meeting." The Air Force acted as host and worked out the assignment of speakers and subjects with other Services.

It was one of the finest meetings, Dr. Jackson stated, that our Association has had. He was particularly impressed, he said, with the wide range and challenging subject matter presented to the Association members by all the speakers at the meeting.

The Defense Department rotates the assignment of host between the three Departments: Army, Navy, and Air Force. The Army will be the host for the Association's next, the 16th Annual Meeting.

GENERALS MOVE UP

The appointment of General L. L. Lemnitzer as Chairman of the Joint Chiefs of Staff will bring changes in the Army top command this fall. General George H. Decker will become Chief of Staff; General Bruce C. Clarke becomes Commander-in-Chief U. S. Army Europe; and Lieutenant General Herbert B. Powell will move from his duties as Commanding General of the Third U.S. Army to Commanding General of the Continental Army Command.

HURRICANE'S REVENGE
or
Hurry and Help Hanson

Commander S. (SHIPWRECK) Hanson got a double dose of Davy Jones' Locker from Hurricane Donna at Norfolk. He is the same well-liked S. (SAMMY) Hanson who was Naval Liaison Officer for the 1959 Annual Meeting of the Armed Forces Chemical Association.

Donna sank both of Commander Hanson's yachts which were moored to pier SP-31 at the Naval Air Station. Navy divers went down to salvage what they could of Cdr. and Mrs. Hanson's personal belongings. The couple were living aboard the "Peggy," a well-appointed 48-foot yacht until other quarters could be established in Norfolk. The other craft, a 26-footer, had been taken to the Naval Air Station in tow and was moored behind the "Peggy."

When the high blow was over, Mrs. Hanson started to re-group her living plans in a pair of borrowed trousers, which were men's size 42. A piece of small line helped to take in the 17 inches extra around her waist.

Commander Hanson, as everybody knows, is an old hunter of hurricanes, and when he served with the Hurricane Hunter Squadron he looked them in the eyes, so to speak. On this occasion, however, it was Donna who found Sammy Hanson.

GENERAL STUBBS SPEAKS TO ANNUAL MEETING IN DUAL ROLE

Major General Marshall Stubbs, Chief Chemical Officer, United States Army, spoke to the 15th Annual Meeting of the Armed Forces Chemical Association in his dual role as both honorary president of the Association and as Chief Chemical Officer of the military service.

He told the meeting that the need for information about CBR is not confined to the general public, but the Chemical Corps plans to increase the flow of information on these subjects to the scientific community. Speaking to the members of the Armed Forces Chemical Association as their honorary president, he said:—

"We know that there is a vast amount of scientific knowledge available which could contribute materially to the solution of problems which concern us. I should like to discuss now some of our research and development problems on which we need the best thinking that can be brought to bear. We believe that we can obtain a great deal of help from the nation's scientists and this is why we are concerned with providing information to the scientific community."

As he continued his remarks, as a member of the Armed Forces Chemical Association, the General said:

"We have made progress. We expect to make much more, and we cannot take forever to do it. We are now entering a period where we must plan to move forward at an even greater pace. We shall be able to do this only with your continued interest and assistance."

In opening his talk, General Stubbs said that speaking to this meeting and the previous meetings of the Association, he had stressed the need for awareness to the threat of chemical and biological weapons in the hands of an enemy. He pointed out that he as well as the other speakers who have stressed this subject repeatedly have done so on purpose to be sure that there is a recognition of this very grave danger.

Addressing himself to the problems of the Chief Chemical Officer, General Stubbs outlined the problems in the detection of chemical or biological agents in the air. The Army is working on a number of warning devices to provide rapid detection of chemical agents in the air. One, the General said, continually samples the air and through chemical reaction sounds an alarm when a toxic agent is present.

There are also methods using infra-red. There are, too, chemical agents which act upon contact with the skin, and protective clothing, as well as masks are needed to ward off damage from these chemicals.

In protection against biologicals, General Stubbs said that, as soon as determination is made that pathogenic organisms are present in the air, these organisms must be sampled and then identified. One device to do this counts individual particles in the air, and sudden increase in air particles might indicate that something unusual is happening which could be the sign that BW attack has taken place. A warning device will tell if something is in the air, but the problem is to compress the time it takes to identify the contents of the air.

General Stubbs also spoke of the incapacitating agents as holding promise for a new concept of imposing force upon the enemy without killing him.

Defensively, immunization with aerogenic vaccines has possibilities, the General said. Laboratory experiments have shown that greater immunity to tularemia is provided by inhalation of live vaccine aerosol than by vaccination on the skin. This may open the possibility to protect masses of people by spraying them with aerosols, which will give them immunity against a number of diseases.

IN THE NUCLEAR AGE

The USS Enterprise, a nuclear powered aircraft carrier, is the newest ship in the Navy and also the world's largest. The ocean-going liners UNITED STATES and AMERICA could both fit on the deck of the ENTERPRISE. Her crew of officers and men number 4,600 and their skills and training include nuclear power plants, electronics, and jet propulsion, as well as naval and aerial warfare.

She can go 20 times around the earth at speeds up to 30 knots without stopping to re-fuel. The ENTERPRISE is 1101 feet long and 252 wide at her flight deck extremes. She displaces 85 000 tons. Four aluminum elevators deliver four aircraft per minute from the hangar deck to the flight deck.

The USS ROBERT E. LEE (SSBN 601), nuclear-powered polaris missile submarine, is moored in the shadows of the newly launched aircraft carrier ENTERPRISE.

Mrs. William B. Franke, wife of the Secretary of the Navy, breaks the traditional champagne bottle across the bow of the ENTERPRISE as the first nuclear-powered aircraft carrier of the U.S. Navy goes down the ways.

CERTIFICATE AWARDED TO COL. HARRY KUHN

Brig. General William E. R. Sullivan awarded a "Blue Sky Certificate" to Colonel Harry A. Kuhn, USA Retired for his suggestion that toxicological research in general be placed under the direction of ARPA, and that the Army Chemical Center do the work.

Colonel Kuhn's idea was to have the Chemical Corps become a central agency in the Department of Defense for the determination of toxicity of propellants and other chemical products which might become health hazards under working conditions.

The Office of the Secretary of Defense approved the general idea and administration of the program was assigned to the Chemical Corps.

GENERAL MARSHALL BIOGRAPHY

General of the Army Omar N. Bradley announced that General of the Army George C. Marshall's biography will be published in three volumes by the Viking Press. The author, Dr. Forrest C. Pogue, director of the George C. Marshall Research Center, has been assisted by Brig. General Frank McCarthy, who was Secretary of the General Staff for General Marshall in World War II. Each of the three volumes will cover different periods in the life of General Marshall.

Randall L. Woods has been appointed editor of the PIONEER, an employe publication of the United States Borax & Chemical Corporation. He is a former San Antonio (Tex.) newsman.

Mrs. Eugene H. Bishop has been named chairman of the Womens' Club, Pine Bluff Arsenal Officers Open Mess.

M/Sgt. Herman Bellucci, a veteran of WW II, transferred from duty with the 15th Chemical Group in Germany to Pine Bluff Arsenal.

GROUP AND SUSTAINING MEMBERS

OF THE ARMED FORCES CHEMICAL ASSOCIATION

Abbott Laboratories, North Chicago, Ill.
Adache Associates, Inc., Engineers, Cleveland, Ohio
Aerojet General Corporation, Downey, Calif.
Aircraft Armaments, Inc., Cockeysville, Md.
Air Reduction Company, Inc., New York, N.Y.
Allied Chemical Corporation, New York, N.Y.
American Cyanamid Company, New York, N.Y.
American Potash & Chemical Corporation, 300 West Sixth, St., Los Angeles 54, California
American Zinc, Lead & Smelting Co., St. Louis, Mo.
Armstrong Cork Company, Lancaster, Pa.
Astra Pharmaceutical Products, Inc., Worcester 6, Mass
Atlas Powder Company, Wilmington, Del.
Avco Corporation, 750 Third Ave., New York 17, N.Y.
Barnebey-Cheney Company, Columbus, Ohio
Bechtel Corporation, San Francisco, Calif.
Blaw-Knox Company, Pittsburgh, Pa.
Brothers Chemical Company, 575 Forest St., Orange, N.J.
Brown Company, 150 Causeway St., Boston, Mass.
Casco Products Corporation, Bridgeport, Conn.
Celanese Corporation of America, New York, N.Y.
City Chemical Corp., New York, N.Y.
Columbia-Southern Chemical Corp., Pittsburgh, Pa.
Commercial Solvents Corporation, New York 16, N.Y.
Continental Oil Co., Ponca City, Okla.
Diamond Alkali Company, Cleveland, Ohio
Dow Chemical Company, Midland, Mich.
E. I. duPont de Nemours & Co., Inc., Wilmington, Del.
Edo Corporation, College Point, N.Y.
Engelhard Industries, Newark, N.J.
Esso Research and Engineering Co., Linden, N.J.
Evans Research & Development Corp., New York, N.Y.
Federal Laboratories, Inc., Saltsburg, Pa.
Ferguson, H. K., Company, The, Cleveland, Ohio
Ferro Corporation, Cleveland, Ohio
Firestone Rubber and Latex Division of Firestone Tire & Rubber Co., Fall River, Mass.
Fisher Price Toys, Inc., East Aurora, N.Y.
Fisher Scientific Co., New York, N.Y.
Fluor Corporation, Ltd., The, Whittier, Calif.
Food Machinery & Chemical Corporation, New York, N.Y.
Fraser & Johnston Co., San Francisco, Calif.
General Aniline & Film Corporation, New York, N.Y.
General Electric Company, Chemical & Metallurgical Division, Pittsfield, Mass.
General Tire & Rubber Company, The, Wabash, Ind.
Goodrich, B. F., Chemical Company, Cleveland, Ohio
Harshaw Chemical Company, The, Cleveland, Ohio
Harvey Aluminum, Torrance, Calif.
Hercules Powder Company, Wilmington, Del.
Heyden Newport Chemical Corporation, New York, N.Y.
Hooker Chemical Corporation, Niagara Falls, N.Y.
Industrial Rubber Goods Company, St. Joseph, Mich.
International Nickel Co., Inc., New York, N.Y.
International Salt Co., Inc., Scranton, Pa.
Kennecott Copper Corporation, New York, N.Y.
Koppers Company, Inc., Pittsburgh, Pa.
Lambert-Hudnut Mfg., Laboratories, Inc., Lititz, Penna. subsidiary of Warner-Lambert Pharmaceutical Company, St. Louis, Mo.
Eli Lilly and Co., Indianapolis 6, Ind.
Little, Arthur D., Inc., Cambridge, Mass.
Lummus Company, The, 385 Madison Ave., New York, 17, N.Y.
Merck & Company, Inc., Rahway, N.J.
Mine Safety Appliances Co., Pittsburgh, Pa.
Minnesota Mining & Manufacturing Co., 900 Fauquier Avenue, St. Paul, Minnesota
Monsanto Chemical Company, St. Louis, Mo.
National Lead Co., 111 Broadway, New York 6, N.Y.
Niagara Blower Co., New York, N.Y.
Olin Mathieson Chemical Corp., 10 Light St., Baltimore, Md.
Oronite Chemical Company, San Francisco, Calif.
Pemco Corporation, Baltimore, Md.
Pennsalt Chemicals Corporation, Philadelphia, Pa.
Pfizer, Chas. & Company, Inc., Brooklyn, N.Y.
Pfaudler Company, a Division of Pfaudler Permutit, Inc., Rochester 3, New York
Phillips Petroleum Company, Bartlesville, Okla.
Pittsburgh Chemical Co., Pittsburgh, Pa.
Procter & Gamble, Cincinnati, Ohio.
Reynolds Metals Company, 6601 W. Broad St., Richmond, Va.
Shell Chemical Corp., Denver, Colo.
Shell Development Company, Emeryville, Calif.
Sheller Mfg. Co., Dryden Rubber Div., Chicago, Ill.
Shwayder Bros., Inc., Denver, Colo.
Standard Oil Company (Indiana), Chicago, Ill.
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United States Borax & Chemical Corp., 630 Shatto Place, Los Angeles 5, Calif.
Vitro Corporation of America, New York, N.Y.
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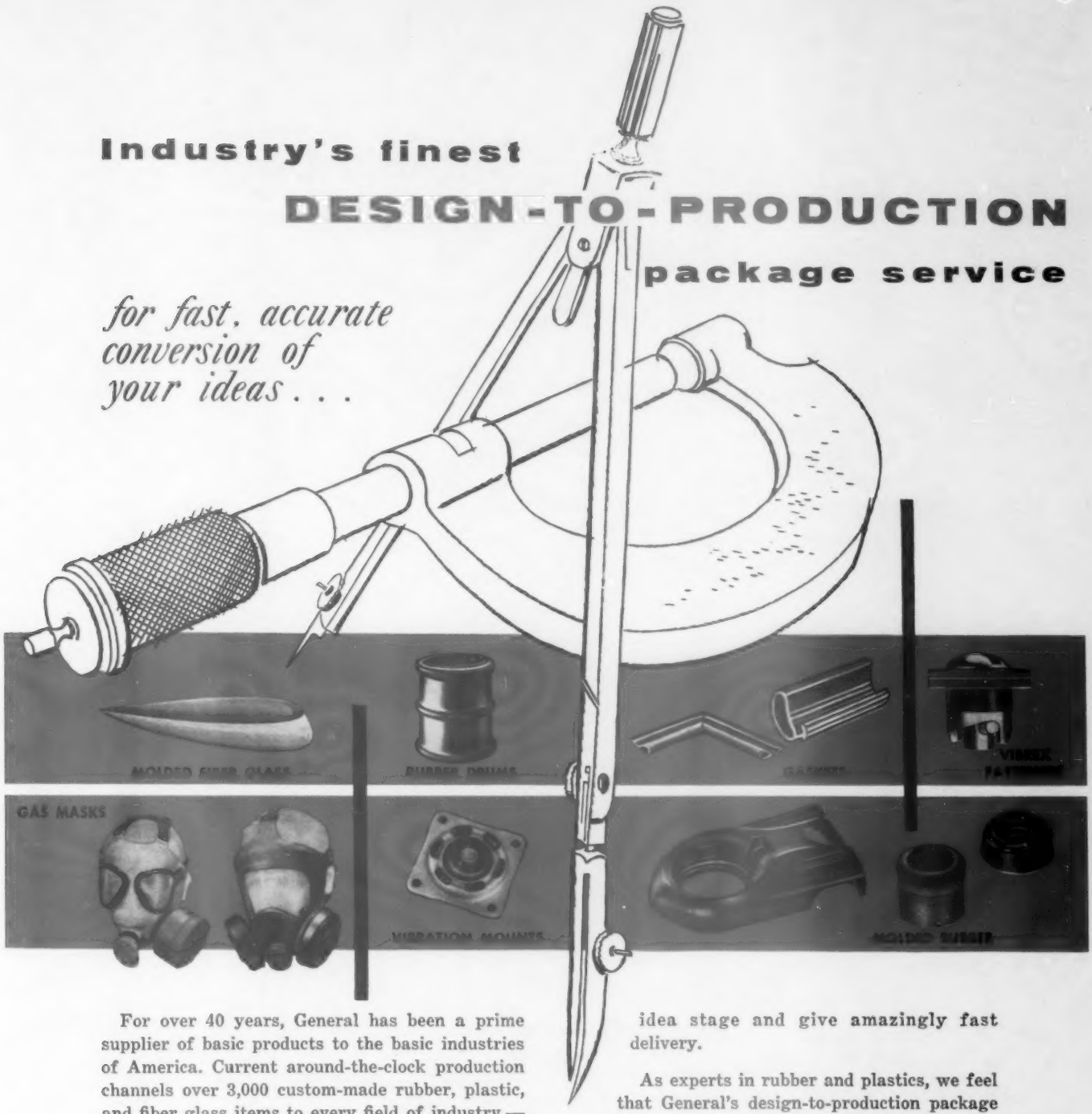

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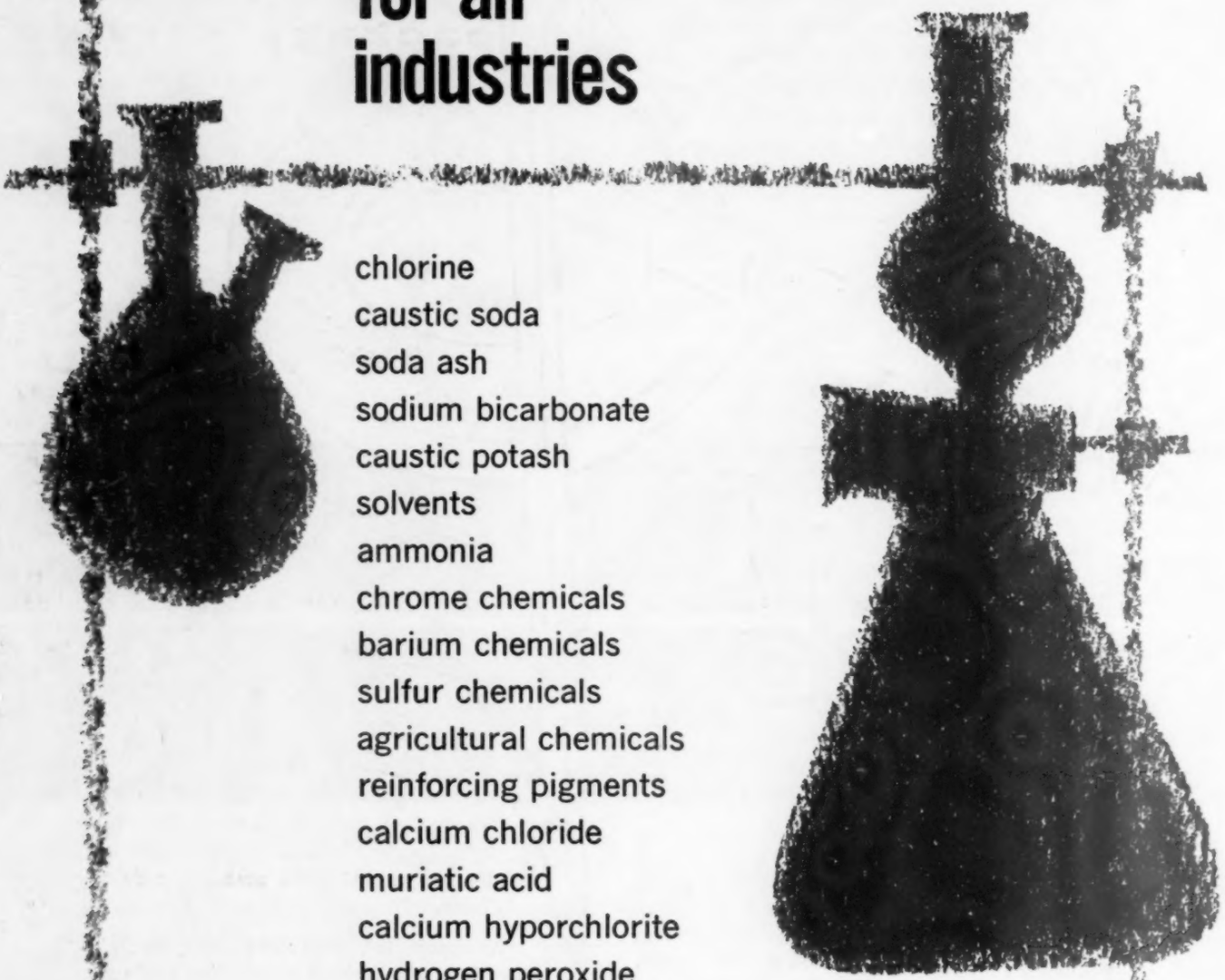

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